1039

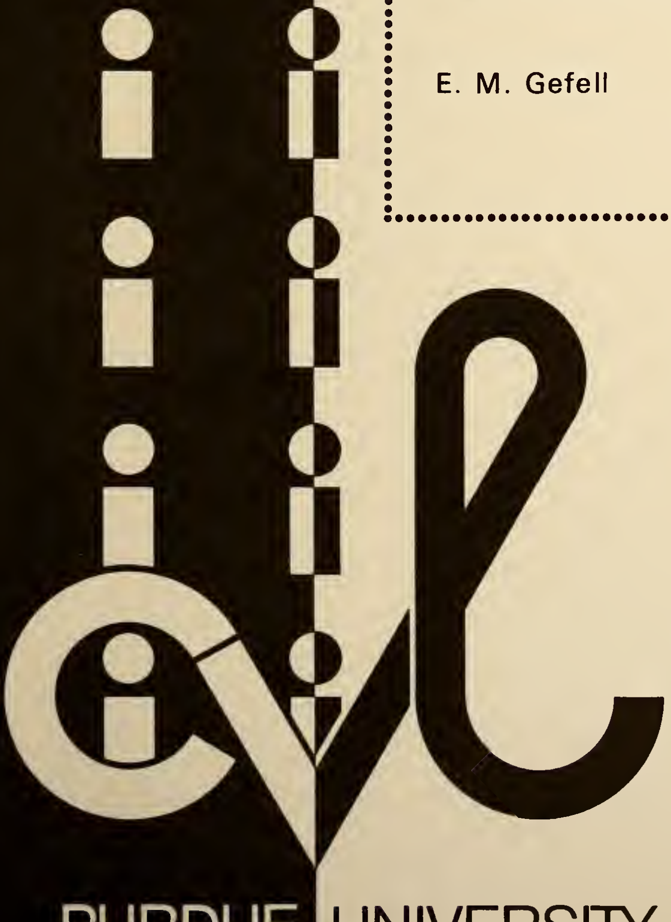
SCHOOL OF CIVIL ENGINEERING

INDIANA DEPARTMENT OF HIGHWAYS

JOINT HIGHWAY
RESEARCH PROJECT
JHRP-82-19

ENGINEERING SOILS MAP OF CLINTON COUNTY, INDIANA

E. M. Gefell



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Final Report

ENGINEERING SOILS MAP OF CLINTON COUNTY, INDIANA

TO: H. L. Michael, Director
Joint Highway Research Project

FROM: R. D. Miles

October 26, 1982

Project: C-36-51B

File: 1-5-2-67

Attached is the Final Report on the "Engineering Soils Map of Clinton County, Indiana". The map and report have been produced by Mr. E. M. Gefell, Graduate Assistant on our staff under the direction of Professor R. D. Miles.

This is the 66th county map which has been completed and adds one more to the growing list of counties for which an engineering soils map is available. Mr. Gefell has developed this map and report in an expeditious manner using available information. The map and report are excellent and should be very useful in planning and developing engineering facilities in Clinton County.

The Report is presented to the Board as completion of the Clinton County engineering soils mapping project.

Sincerely,

Robert D. Miles

Robert D. Miles

RDM:ms

cc:
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Final Report

ENGINEERING SOILS MAP OF CLINTON COUNTY, INDIANA

by

E. M. Gefell
Graduate Assistant

Joint Highway Research Project

Project No.: C-36-51B

File No.: 1-5-2-67

Prepared as Part of an Investigation

Conducted by

Joint Highway Research Project
Engineering Experiment Station
Purdue University

In Cooperation with

Indiana Department of Highways

Purdue University
West Lafayette, Indiana
October 26, 1982

ACKNOWLEDGMENTS

The author wishes to thank Dr. D. W. Levandowski and Dr. T. R. West of the Department of Geosciences, Purdue University for their permission and recommendations for him to work on the JHRP engineering soils mapping project. He is especially grateful to Professor R. D. Miles, professor in charge, for his always enthusiastic assistance and guidance with the research, mapping, and report writing undertaken in this project. The author also wishes to recognize Professor H. L. Michael, Director, Joint Highway Research Project, and the other members of the JHRP Board without whose consent he would not have been allowed the privilege of working on and producing this publication.

All airphotos used in connection with the preparation of this report automatically carry the following credit line: photographed for Commodity Stabilization Service, Performance and Aerial Photography Division; United States Department of Agriculture.

ENGINEERING SOILS MAP
OF
CLINTON COUNTY, INDIANA

Introduction

The engineering soils map of Clinton County, Indiana (see Figure 1) which accompanies this report, was made primarily by interpretation of aerial photographs. Extensive use was made of the U.S.D.A. Soil Survey of Clinton County (1). The U.S.D.A. pedological soil series were grouped according to parent material and these areas delineated on the Soil Survey map sheets. A photomosaic of Clinton County was constructed from aerial photographs and the parent material areas were found on the photomosaic (a 1957 index photomosaic of Clinton Co. is shown in Figure 2). Modifications of the parent material areas were made by the author on the photomosaic according to aerial photographic interpretation of land forms and field sampling information. The aerial photographs used were taken in 1939 for the U.S. Department of Agriculture and were printed at an approximate scale of 1:20,000.

Aerial photographic interpretation of the land forms, parent materials, and soil textures was done in compliance with accepted principles of observation (2). Numerous field trips were taken to the county to resolve ambiguous details and to correlate aerial photographic interpretation of soil textures with that actually found in the field. Standard symbols developed by the

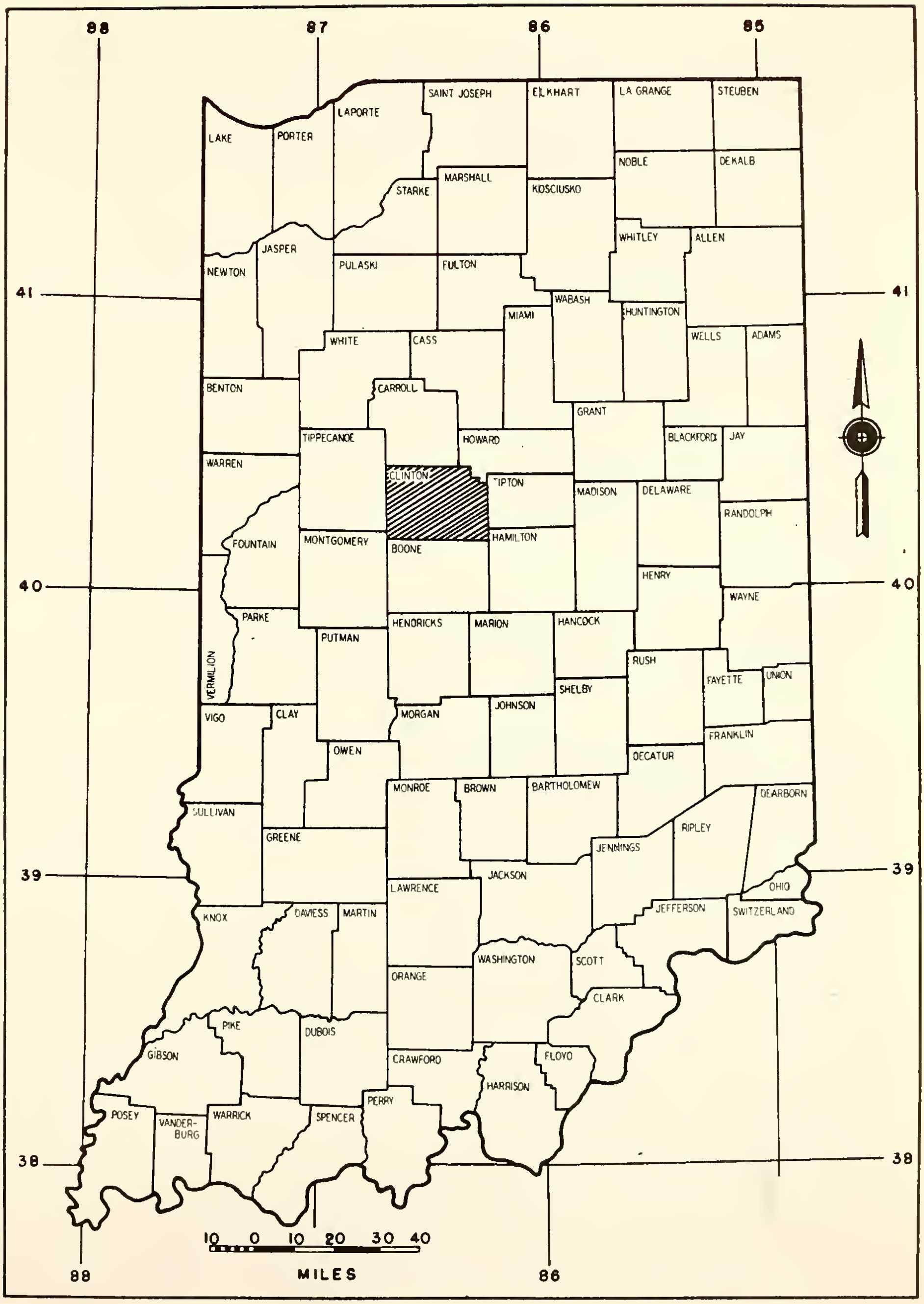


FIGURE 1. LOCATION OF CLINTON COUNTY

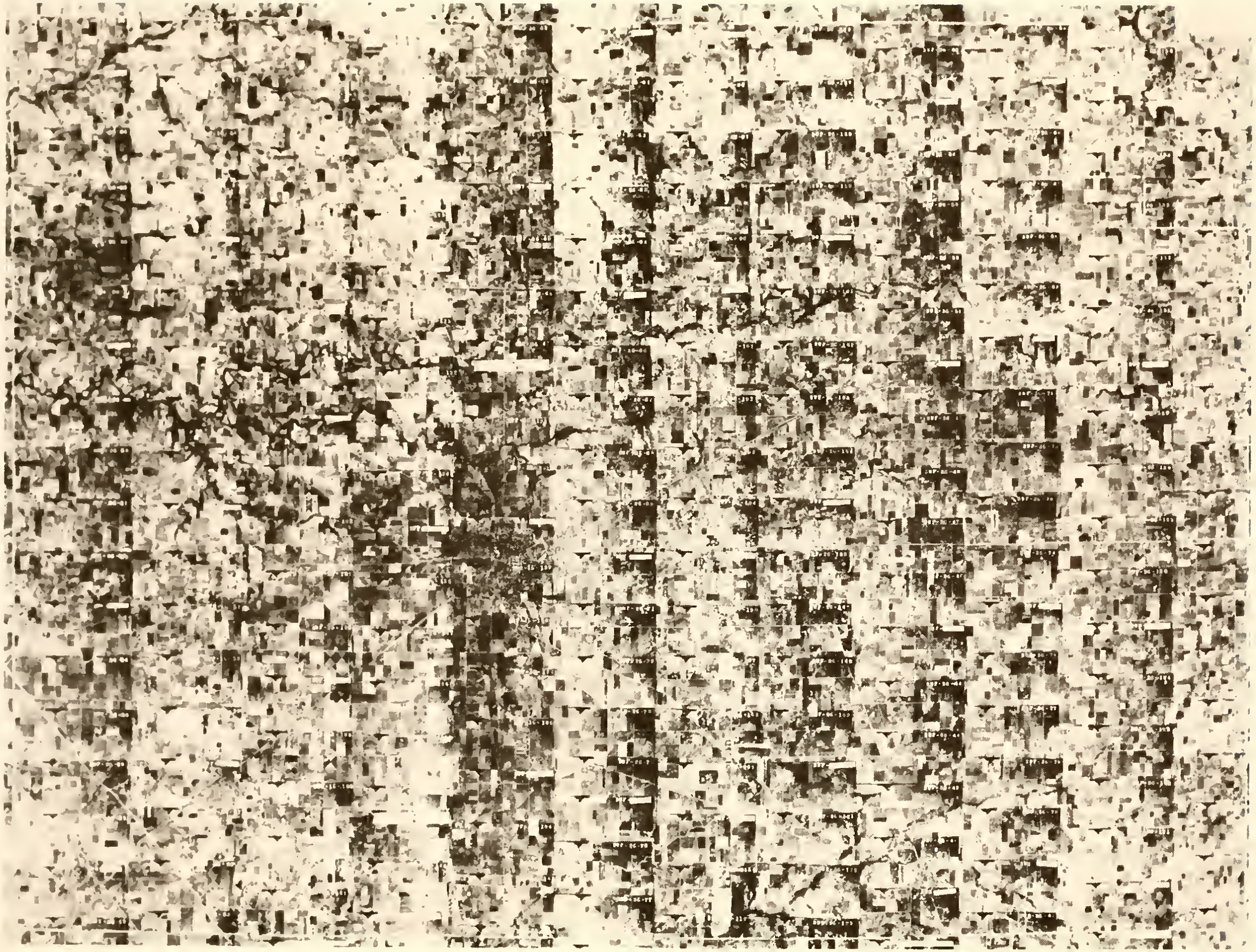


FIGURE 2 PHOTOMOSAIC OF CLINTON COUNTY

staff of the Airphoto Interpretation Laboratory, School of Civil Engineering, Purdue University, were used to identify land form-parent material associations and soil texture on the engineering soils map.

The map and report was part of an on-going effort to complete a county by county, comprehensive engineering soils survey of the State of Indiana using a standard set of symbols. All map units of any given county were to correlate with those of all adjacent counties. In some places, extent of a land form-parent material association of an adjacent county was limited to a small area near the Clinton County line in order that consistency of interpretation of that particular land form be maintained.

Description of the Area

General

Clinton County is located in mid-central Indiana. It is rectangular in shape, bounded on the west by Montgomery and Tippecanoe Counties, on the north by Carroll and Howard Counties, to the east by Hamilton and Tipton Counties and to the south by Boone County (see Figure 1). Maximum north-south distance is about 17 miles and the maximum length from east to west is approximately 24 miles. Clinton County covers an area of 260,480 acres or roughly 407 sq. miles (1).

The city of Frankfort, situated in the central part of the county, is the seat of government. Frankfort is linked to the following communities by transportation systems: Colfax to the

southwest; Mulberry and Rossville to the northwest; Michigantown to the northeast, and Kirklin to the southeast.

The total population of Clinton County was 31,525 according to the 1980 census (3), sixty percent, (19,046), of which were living in rural areas. Populations of the major cities and towns are listed in Table 1. Most of the soils of Clinton County, Indiana were farmed extensively. Grain was the principle crop and hogs were raised by many farmers. Much of the county was poorly drained and required subsurface or open-ditch drainage, or both. Industry in Frankfort, Lafayette in Tippecanoe County, and Kokomo in Howard County provided employment for that part of the labor force not engaged in agriculture (1).

Table 1. Population Data for Clinton County (3)

City or Town	1980 Population
Frankfort	15,168
Mulberry	1,225
Rossville	1,148
Colfax	823
Kirklin	662
Michigantown	453

Groundwater wells were the main source of domestic water in Clinton County. The principle source of groundwater was sand and gravel layers within the glacial till. The pre-glacial Teays River and its tributary valleys buried beneath the glacial drift in the southern part of the county provided well water for Frankfort′s industrial and municipal use (1).

Climate

The climate of Clinton County is continental and temperate with hot, somewhat humid summers and moderately cold winters. Annual precipitation at Frankfort averages 39 inches, 62 percent of which occurs between April and September. Clinton County can expect to receive, on the average, about 25 inches of snow per year. Table 2 summarizes the climatological data recorded at Frankfort from 1941-1970 (9).

Drainage Features

Nearly all of Clinton County lies within the Wabash River drainage basin. Runoff from the northern two-thirds of the county flows into the Wildcat Creek subdivision of the Wabash drainage basin. Runoff from the southern third of the county also reaches the Wabash, except for that from a small area (about two square miles) in the southeastern part of the county which flows to the White River (4). Preglacial drainage was evidently through the Anderson Valley, a part of the Teays River System (4,10). Information on drift thickness (5), (see Figure 6), and bedrock stratigraphy (6), (see Figure 7), indicate the preglacial flow was to the southeast.

The system of drainage in the county is roughly divided into three sections by two east-west trending moranic "highs". In some places, the morainic highs are ridge moraine. However, field investigations showed that drainage divides cannot as a rule be inferred to be ridge moraine as had previously been suspected by Malott (1922) (7), and Leverett, (1915) (8).

Table 2

U. S. DEPARTMENT OF COMMERCE
IN COOPERATION WITH FRANKFORT CHAMBER OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
CLIMATOGRAPHY OF THE UNITED STATES NO. 20 - 12

CLIMATOLOGICAL SUMMARY

Station: Frankfort, Indiana

MEANS AND EXTREMES FOR PERIOD 1941-1970

Month	Temperature (°F)							**	Precipitation Totals (Inches)								Mean number of days					Month
	Means			Extremes								Snow, Sleet						Temperatures				
																		Max.		Min.		
	Daily maximum	Daily minimum	Monthly	Record highest	Year	Record lowest	Year	Mean degree days	Mean	Greatest daily	Year	Mean	Maximum monthly	Year	Greatest daily	Year	Precip. .10 inch or more	90° and above	32° and below	32° and below	0° and below	
(a)	30	30	30	30		30		20	30	30		30	30		30		17	30	30	30	30	
Jan.	34.8	17.2	26.0	70	1950	-23	1963	1239	2.23	2.88	1950	5.0	10.0	1964	6.0	1965+	4	0	13	28	4	Jan.
Feb.	37.8	19.5	28.7	69	1944	-20	1963	1024	2.15	2.01	1964	6.0	16.1	1964	8.0	1960	4	0	9	26	2	Feb.
Mar.	47.8	28.1	38.0	79	1967+	-16	1948	861	2.93	2.47	1954	3.7	15.0	1960	4.0	1968+	6	0	3	22	*	Mar.
Apr.	61.8	39.6	50.7	88	1960+	19	1962+	438	4.04	3.16	1964	.3	4.5	1961	3.5	1961	8	0	*	8	0	Apr.
May	72.2	49.7	61.0	94	1964	24	1968	182	4.38	4.45	1943	T	T	1969+	T	1969+	8	1	0	1	0	May
June	81.8	59.0	70.4	100	1944	31	1945	28	4.22	3.47	1958	0	0		0		6	6	0	*	0	June
July	85.2	62.0	73.6	102	1954	42	1947	4	4.13	2.88	1957	0	0		0		7	8	0	0	0	July
Aug.	83.7	59.5	71.6	100	1948	33	1946	14	2.92	3.28	1954	0	0		0		4	6	0	0	0	Aug.
Sept.	77.2	52.1	64.7	99	1953	26	1942	104	3.00	3.92	1950	0	0		0		5	2	0	1	0	Sept.
Oct.	66.6	41.7	54.2	89	1946	17	1962+	362	2.80	2.36	1969	T	T	1967+	T	1967+	5	0	0	7	0	Oct.
Nov.	49.6	31.1	40.4	76	1944	-04	1950	745	2.91	2.40	1958	1.5	5.0	1955	4.0	1955	6	0	2	18	*	Nov.
Dec.	37.7	21.0	29.4	68	1970+	-18	1963	1105	2.21	3.48	1967	4.7	13.0	1960	6.0	1951	6	0	10	27	2	Dec.
Year	61.4	40.0	50.7	102	July 1954	-23	Jan. 1963	6106	37.92	4.45	May 1943	21.2	16.1	Feb. 1964	8.0	Feb. 1960	69	23	37	138	8	Year

(a) Average length of record, years.
T Trace, an amount too small to measure.
** Base 65° and computed from monthly mean temperatures

+ Also on earlier dates, months, or years.
* Less than one half.
Observation time: Midnight

CLIMATE OF FRANKFORT, INDIANA

Frankfort has an invigorating climate because of frequent changes of Weather. The city is located in the middle latitudes where air of polar and tropical origins frequently clash and where the moderating effects of the oceans are least.

Centers of low air pressure frequently move across the central plains through Indiana, to the St. Lawrence River Valley and the Atlantic Ocean. These storms which accompany most rains usually are preceded by southerly winds, declining air pressure and increased cloudiness; afterwards come lower temperatures, higher air pressure and much sunshine.

Precipitation is rather evenly distributed throughout the year, however, the month of May has a little more than other months while winter months have the least. Spring and summer rains are usually sufficient for most crops, particularly when the soil has several inches of water as the result of early spring or winter precipitation.

Temperatures have ranged in the past 30 years from -23° to 102°F. July is the warmest month of the year when days with temperatures exceeding 90° average 8 in number. January is the coldest month. The winter season averages 8 days with temperatures below zero.

Snow has occurred as early as October and as late as May. The most snow comes in February. The greatest snowfall of any one day in the last 30 years was 8 inches recorded February 25, 1960.

Relative humidity varies on a summer day from the 40's during a typical summer afternoon to 90 percent and higher just before dawn. Relative humidity rises and falls much as temperature does during a 24-hour period but the highest percent usually occurs with the minimum temperature. In the winter, the most probable range of relative humidity from afternoon to night is from the 60's to the 90's. Fog is least apt to occur in the summer. At other times of the year, early morning fog is occasionally observed.

Heating degree days are an indication of heating requirements for dwellings in the community. Fuel consumption for heating is proportional to degree day totals, so a month with twice the heating degree days of another month requires twice as much fuel for heating. Degree days for a single day are obtained by subtracting the mean temperature from 65°F.

Frequency of brief heavy rainfall may be estimated from the climatology of the area. A rain of 1.4 inches in one hour occurs about once in 2 years; a rain of 2.0 inches in one hour occurs about once in 10 years; and a rain of 2.3 inches in one hour happens about once in 25 years. In a 6-hour period, 2.2 inches should be expected about every other year. The probability of 3.2 inches in 6 hours is 1 in 10 years and for 3.6 inches, about 1 in 25 years.

Climatology of the area indicates that thunderstorms occur on about 47 days of the year. The average is about 8 a month in the late spring and early summer, and less than one a month in the winter. The thunderstorms are seldom so severe as to cause loss of life, property, or crops. Eleven tornadoes have occurred in Clinton County during the period 1916-1970.

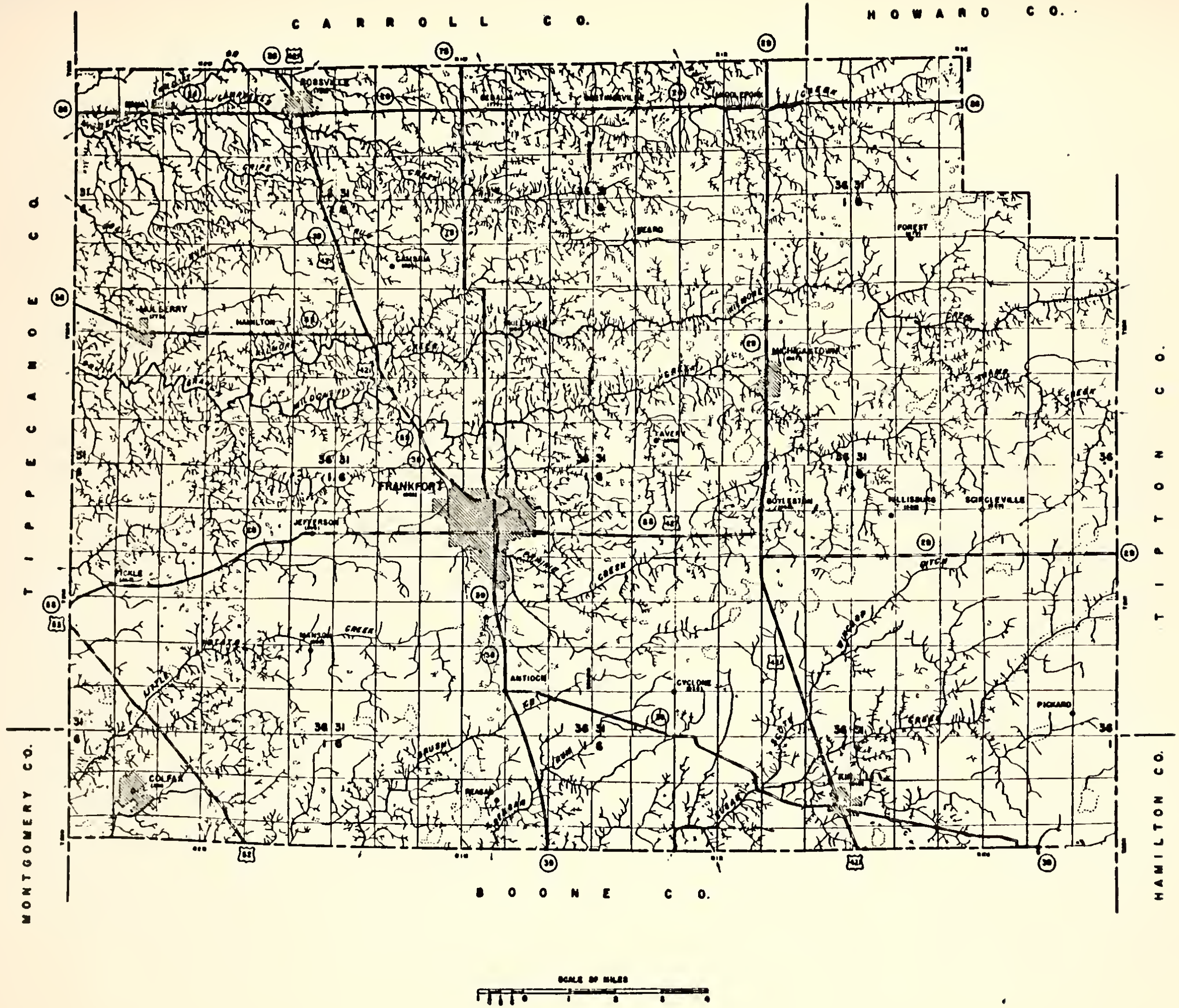
Lawrence A. Schaal, NOAA Climatologist for Indiana
Environmental Data and National Weather Services
Agronomy Department
Purdue University
Lafayette, Indiana 47907

January 1971

The general drainage pattern of Clinton County is regionally dendritic and locally parallel to sub-parallel. In the northern two-thirds of the county, streams flow about due west. Streams in the southern third of the county flow to the southwest, suggesting a change in regional slope at the southern morainic high. The change in attitude of the general streamflow pattern is evident on the drainage map of Clinton County, (see Figure 3), and roughly follows State Road 28.

The northern third of the county is drained by the Middle Fork of Wildcat Creek. Its main tributaries are Campbell's Creek and Cripe and Hog Runs. Runoff from the middle third of the county flows to the west in Kilmore Creek and the South Fork of Wildcat Creek. Little Potato, Brush and Sugar Creeks along with Reagan Run and the Scott Wincoop Ditch drain the southern third of Clinton County. All the aforementioned streams are tributary to the Wabash River in Parke, Fountain, or Tippecanoe County.

The northern two-thirds of the county is much more dissected by 1st and 2nd order streams than the southern third. The headwaters of many of the smaller tributaries are associated with clusters of depressional features on the morainic "highs". In the northern two-thirds of the county, tributaries south of the main streams flow to the northwest, while those to the north are too short to exhibit any definite tendency in direction of flow. Lower order tributaries in the southern third of the county tend to enter the main streams at right angles.



DRAINAGE MAP

FIGURE 3 CLINTON COUNTY

INDIANA

The major streams in Clinton County may be considered subsequent due to glaciation, (i.e., while their general westward flow may not be a result of glaciation, the parallel drainage pattern seen in the county most likely is attributable to the glacial processes and effects of the Wisconsin glacial period). Surface drainage is best developed in the Wildcat and Sugar Creek watersheds. The most prominent localized relief in the county is a result of erosion by these streams. Poor drainage conditions in the south and northeast portions of the county necessitate the excavation and maintenance of man-made ditches in order to keep farmland free of standing water.

No natural lakes exist in Clinton County, however, both man-made and natural ponds are found (1). Natural ponding occurs primarily in depressions in the ground and ridge moraine and is usually seasonal, (i.e., during the spring). Man-made ponds may be the result of abandoned gravel pit operations, old borrow pits, damming of small streams, or farming activities.

Physiography

Clinton County lies entirely within the Tipton Till Plain Physiographic Province of the State of Indiana (see Figure 4). The Tipton Till Plain lies within the Till Plains Section of the Central Lowlands Province of North America (10). The general characteristics of the Tipton Till Plain Province are typified in Clinton County and are herein discussed in some detail.

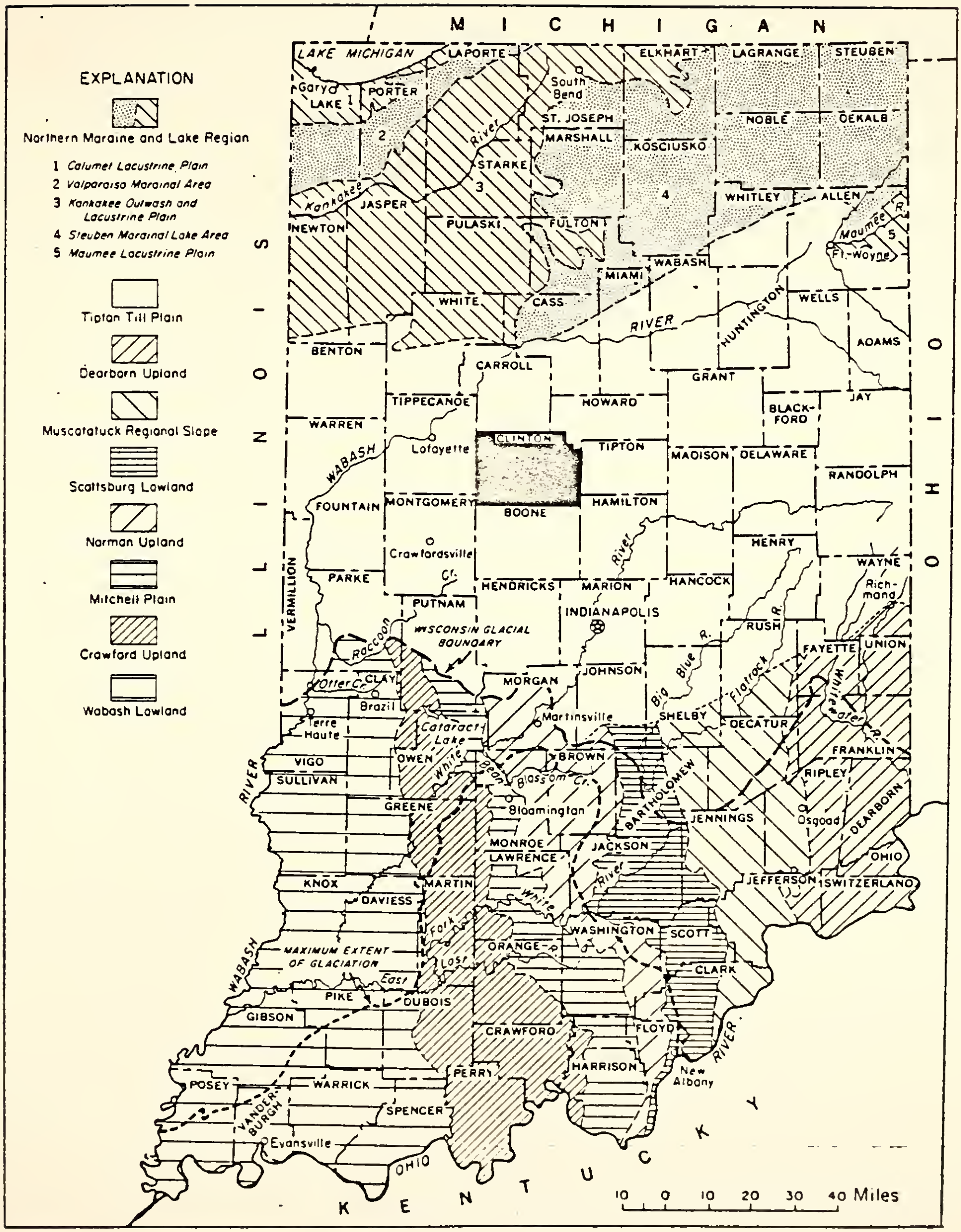


FIGURE 4 Map of Indiana showing physiographic units, glacial boundaries and location of Clinton County (modified from Indiana Geol. Survey Rept. Prog. 7, fig. 1).

Topography

Topography of Clinton County may be described, in general, as flat to gently undulating. Elevation ranges from a high of 940 ft. above sea level in the southeast corner of the county to a low of 640 ft. above sea level where the Middle Fork of Wildcat Creek enters Tippecanoe County in the northwest part of Clinton County (see Figure 5). Additional elevations from railroad grades indicate the till plain slopes regionally in a west-northwesterly direction (10).

The steepest slopes in the county are related to the degradational processes of Sugar and Wildcat Creeks. Local relief along these streams may exceed 100 ft. with slopes of 50 percent or greater in till cuts (4). Relief is notable along the Middle Fork and South Branch of Wildcat Creek near the Tippecanoe County line and near the junction of Kilmore Creek and the South Branch of Wildcat Creek between Mulberry and Frankfort. Relief is also relatively great on Sugar Creek near Kirklin and at the Boone County line (4).

The Tipton Till Plain is characteristically flat to gently undulating with slopes of 2 to 5 percent (10). The ground moraine is interrupted by hummocky areas of ridge moraine, occasional kames of moderate relief (e.g., 20′-40′), ice block depressions, and stream valleys. Surface morphology is primarily a result of the Wisconsinan glaciation and subsequent erosion.

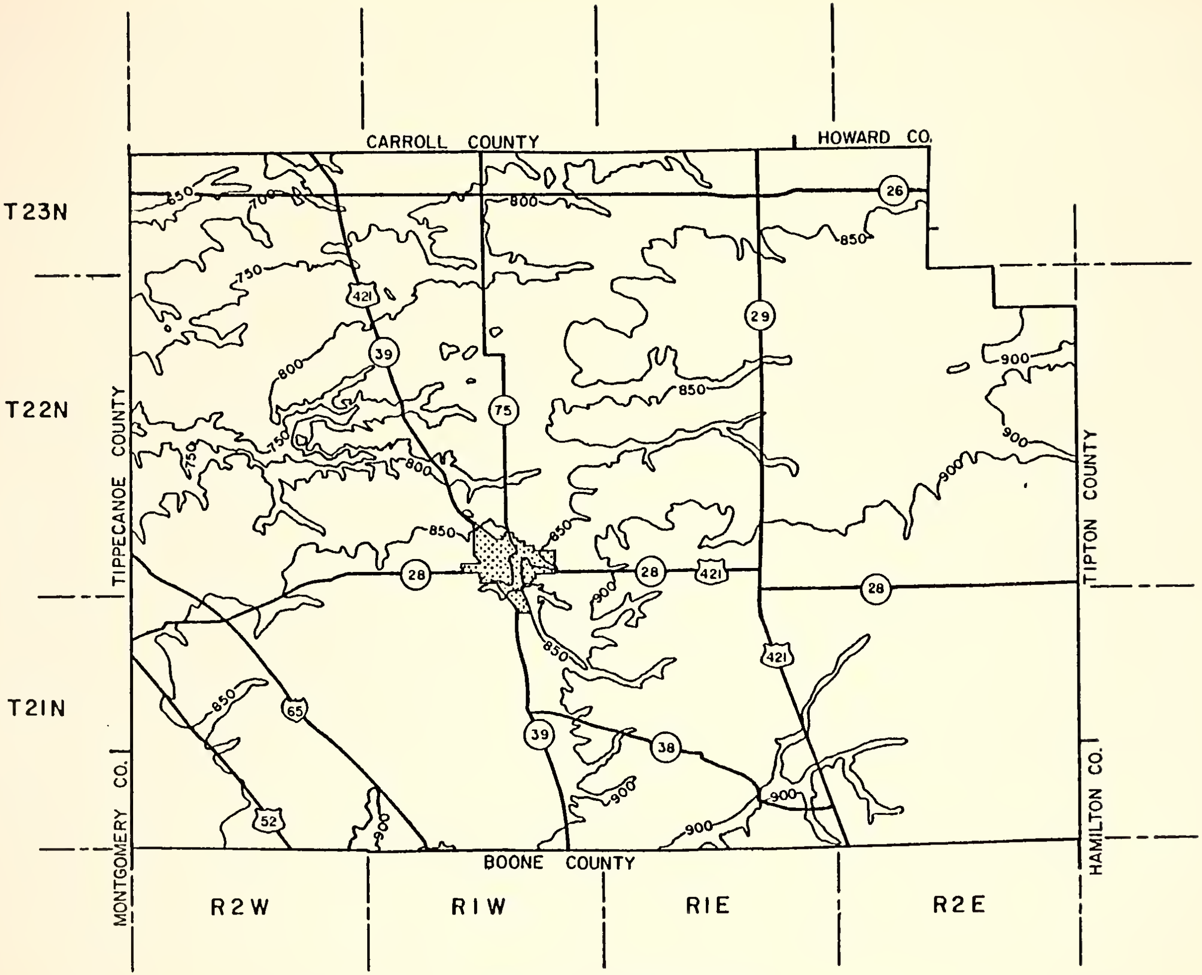


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FIGURE 5 TOPOGRAPHY OF CLINTON COUNTY (Contour Interval 50 Feet) (18)

Glacial Geology

At least three distinct episodes of glaciation, the Kansan, Illinoian, and Wisconsin glacial periods have influenced the recent, surficial geologic history of Clinton County. All constructional glacial features exposed at the surface were formed during the most recent or Wisconsin glacial period and are a part of the Trafalgar Formation (10). The till, outwash, and other deposits of earlier glacial episodes are completely overlain by material of Wisconsin age, with the possible exception of exposures in deep erosional cuts along Wildcat, Kilmore, and Sugar Creeks. Drift thickness throughout the county is shown in Figure 6.

The ice sheet made two separate advances over mid-central Indiana during the Wisconsin glacial period. The first advance deposited the Center Grove, or lower member of the Trafalgar Formation (11). The vertigo alpestris oughtoni, a thin, intraglacial fossiliferous silt bed, marks the boundary between the Catersburg and the underlying Center Grove Members of the Trafalgar Formation (11). Both members are fairly homogeneous mudstone tills with minor amounts of sand and gravel.

Glacial features of Clinton County, Indiana are both constructional and degradational in nature. All morainic surface features not related to post-glacial erosional processes are, of course, directly a result of the Wisconsin glacial period. The constructional surface features of the Wisconsin glaciation in Clinton County are characterized by three primary environmental facies: 1) ridge or recessional moraine; 2) blanket till or

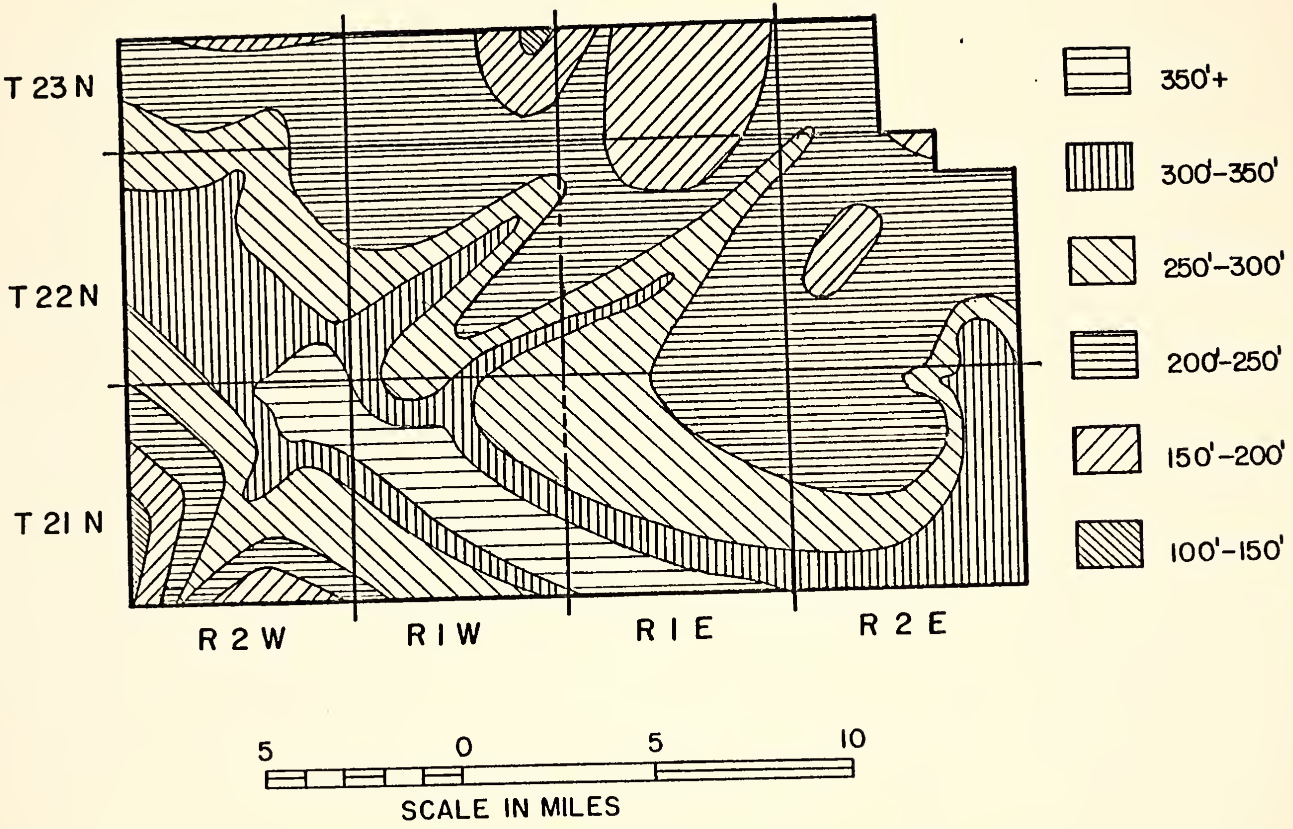

FIGURE 6 DRIFT THICKNESS OF CLINTON COUNTY (5)

ground moraine, and 3) kame and esker or outwash deposits (11). No drumlins were known to exist in Clinton County (10) and none were found by the author. (For precise location of kames, eskers and outwash deposits, refer to the map which accompanies this report.)

Degradational surface features associated with the Wisconsin stage occurred late in that period of glaciation. As the ice retreated, large amounts of meltwater inundated the recently exposed ground moraine resulting in the formation of glacial sluiceways and the enlargement of stream valleys. Most of the evidence for such an occurrence is found in the southern third of the county where several elongate, sandy-silt and gravel deposits are found oriented in a northeast-southwest direction. These deposits are much too broad to have been the product of the small streams which now flow over them. Outwash deposits are also found along the Middle and Southern Fork of Wildcat Creek and on Kilmore and Sugar Creeks. The outwash deposits along the major streams in the northern two-thirds of the county are more terrace-like than their glacial sluiceway counterparts in the southern third.

Kames are fairly numerous in the northern third of the county, particularly near the town of Sedalia. The area around Sedalia may be thought of as a "kame-field". The only esker-like feature or crevasse filling found in the county also occurs in the vicinity of Sedalia. Its precise location is SE 1/4, NE 1/4, Sec 3, T23N, R1W.

Bedrock Geology

Bedrock in Clinton County, Indiana is overlain in most places by 100′-300′ of glacial drift. Information about the geologic substructure has been obtained from oil and gas wells and deep water wells that penetrated bedrock. No bedrock outcrops had previously been located and documented in the county (10), and no outcrops were discovered by the author during the course of this investigation.

The bedrock underlying Clinton County is sedimentary and of Paleozoic Age. Formations of Devonian Age include the New Albany Shale, the North Vernon and Jeffersonville limestones, and the Geneva Dolomite. The Wabash and Waldron Formations and the Louisville Limestone are of Silurian Age. A small amount of the bedrock surface is comprised of the Kenneth and Kokomo Limestone members of the Salina Formation, also of Silurian Age (6) (see Figure 7).

The main structural bedrock feature of Indiana resembles an elongate dome or anticline whose axis is oriented northwest-southeast. Clinton County is located on the western flank of the structure, just beyond the apex. Beds dip, on the average about one degree to the southwest (10). Preglacial erosion of the bedrock surface uncovered rocks of Silurian Age in what appears to be a bedrock valley oriented northwest-southeast in the central part of the county. The drift-filled valley is assumed to be associated with the Teays River System and is presently an

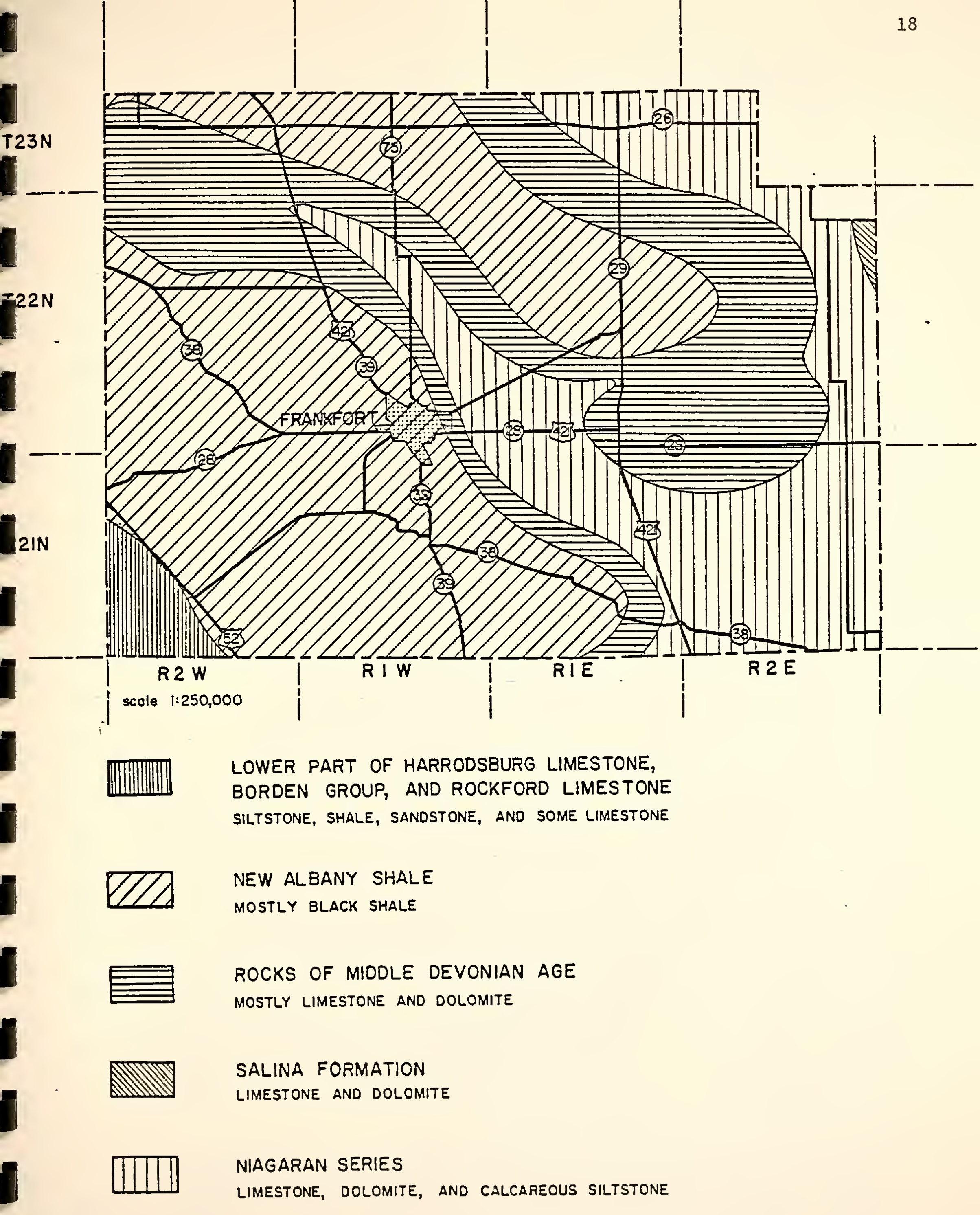
T23N
22N
21N
26
75
29
42
38
39
FRANKFORT
28
421
35
52
R2W
R1W
R1E
R2E
scale 1:250,000
LOWER PART OF HARRODSBURG LIMESTONE, BORDEN GROUP, AND ROCKFORD LIMESTONE
SILTSTONE, SHALE, SANDSTONE, AND SOME LIMESTONE
NEW ALBANY SHALE
MOSTLY BLACK SHALE
ROCKS OF MIDDLE DEVONIAN AGE
MOSTLY LIMESTONE AND DOLOMITE
SALINA FORMATION
LIMESTONE AND DOLOMITE
NIAGARAN SERIES
LIMESTONE, DOLOMITE, AND CALCAREOUS SILTSTONE

FIGURE 7 BEDROCK GEOLOGY OF CLINTON COUNTY (6)

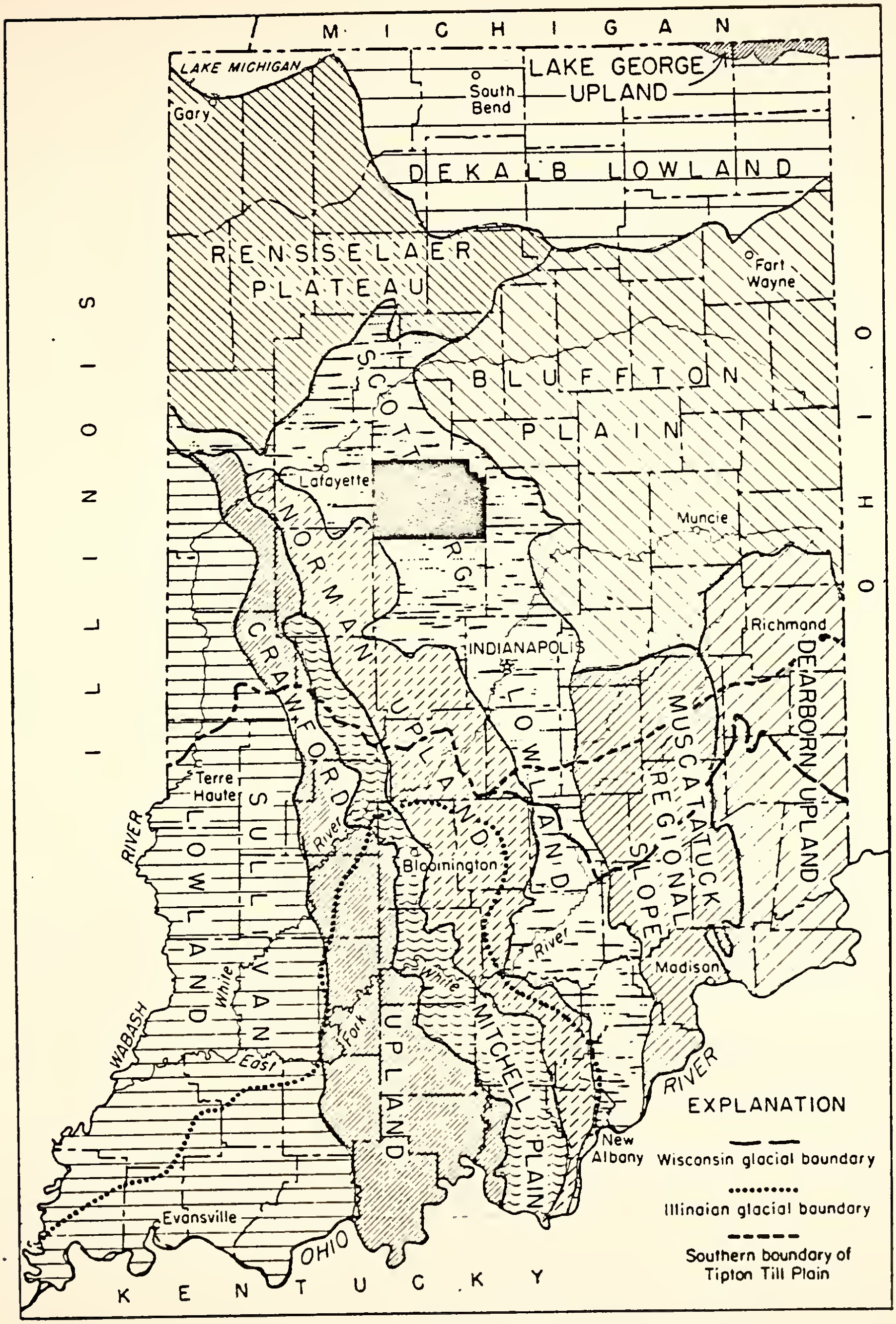

FIGURE 8 Map of Indiana showing bedrock physiographic units and location of Clinton County (from Indiana Geol. Survey Rept. Prog. 7, fig. 3).

excellent source of groundwater. Rocks of Silurian Age are also found in the northeast and southwest portions of the county, while Devonian rocks predominate throughout the rest of the bedrock surface (6). The preglacial bedrock surface of Clinton County is thought to be topographically similar to present day exposures of well developed areas of the Scottsburg Lowland and Norman Upland in the bedrock region of southern Indiana (7), (see Figure 8).

General Mapping Method

The mapping procedure began by assembling a photomosaic of Clinton County and marking the county lines and section corners on the mosaic. Landform-parent material boundaries from adjacent counties were then located on the county lines and labelled. Alluvial and highly organic topsoil deposits as well as several kames were located solely by stereoscopic interpretation of aerial photographs. All other landform-parent material associations were first located on the Clinton County Agricultural Soil Survey Map by grouping the soil series according to parent material and identifying them with a pencil color-code on the agricultural map sheets. These areas were then located and delineated on the photomosaic. Additions and deletions of the boundaries from the agricultural map were made by analytical airphoto interpretation.

Several field trips were made to the county to verify boundaries and sample deposits. Verification of areas of peat and muck, highly organic topsoils and kames were the primary goals of

the sampling carried out in the county. Detection of the rather subtle difference between ridge and ground moraine was complicated by stream dissection in the northern two-thirds of the county and was in some places indiscernible. In order to show a good, general picture of the morainic system in the county, a "crossroads survey" was undertaken wherein at every intersection encountered on the field trips, the surrounding land was identified as ridge or ground moraine. In this way, a "physiographic map" of the county was constructed, roughly depicting the distribution of ridge and ground moraine.

Information obtained in the field was used to modify the boundaries previously established on the photomosaic. Several low kames, not originally recognized in the aerial photographs, were located in the field and delineated on the mosaic.

When the boundaries on the photomosaic proved to be satisfactory, the scale of the map was reduced from three inches per mile to one inch per mile with a mechanical reducing device. The one inch per mile map was the pencil copy. Any additional modifications were easily accommodated on the pencil copy. The final published map contained herein was prepared by ink-tracing of the pencil copy. Appropriate symbols were used to identify the land form type, parent materials, and the general texture of the soils, (e.g., sand, silt, clay or gravel).

Engineering Soils Areas

Glacial Deposits

Glacial deposits were subdivided into drift deposited by the ice itself and material deposited by meltwater derived from the ice. Ice deposited land form-parent material associations include ground and ridge moraine. Deposition occurred during active glaciation or by ablation of a stagnant ice mass in the case of ground moraine. Meltwater deposits include kames, outwash terraces, glacial sluiceway sediments and an esker-like feature near the town of Sedalia.

Ice-Contact Deposits

The texture of ridge and ground moraine in Clinton County is somewhat similar. The ridge moraine is characterized by a clayey silt with some sand and pebbles, whereas the ground moraine is typically a silty clay with some sand. Swells in the ridge moraine are typically composed of hard, dense, and compact soils. Swales in the ground moraine were composed of a mottled, gray-yellow, plastic clay.

The predominant soils developed on ridge and ground moraine include the following*:

Soil Series/Association		Percent of County Area
Fincastle-Crosby		24.3
Miami-Crosby		15.7
Cyclone		11.7
Fincastle		5.0
Ragsdale		4.8
Drummer		4.0
	Total	65.5 Percent

*Note: The engineering characteristics of these and all the predominant soil series subsequently mentioned with regard to engineering soils areas are summarized in Appendix B in the back of this report.

The following representative borehole logs of ground and ridge moraine were arrived at by averaging the data from several road soil survey boreholes for both ridge and ground moraine. The boreholes indicated for each land form are along Interstate 65 and are shown on the engineering soils map.

Ground Moraine (boreholes 15-20)

Depth (feet)	Textural Classification	AASHTO	P.I.
0-2	Brown silty clay, moist, medium stiff	A-6(9)	13
2-4	Mottled gray and brown silty clay, moist stiff	A-7-6(17)	30
4-6	Brown and gray clay loam, trace gravel, moist, medium stiff	A-6(9)	13
6-10	Brown and gray silt loam, little gravel, moist, medium stiff	A-4(5)	6

Ridge Moraine (boreholes 2, 3, and 7)

0-2	Brown sandy clay loam	A-6(7)	11
2-4	Brown sandy clay	A-6(5)	14
4-6	Brown sandy clay loam	A-6(5)	15
6-10	Gray sandy loam	A-4(1)	6

The borehole data indicate the ridge moraine is generally more homogeneous than the ground moraine. The data also shows that the ridge moraine is more sandy (i.e., coarser textured), and typically has a lower plasticity index in the B-horizon (2-4 feet).

Meltwater Deposits and Kames

Coarse-Textured Outwash Terraces

The average grain size of meltwater deposits is more coarse than adjacent ice contact deposits. Kames exhibit a sandy-gravelly texture with silt and some clay. Although positive verification was not possible due to their inaccessibility and

lack of proper sampling equipment, the larger kames in the county are assumed to undergo a transition to stratified sands and gravels at an approximate depth of 6 to 10 feet as is typical of kame deposits. Outwash terraces are commonly topographically higher than more recent terraces and flood plains not related to glaciation, and are generally coarser textured deposits than their contemporary counterparts. In addition, the outwash terraces are broad and benchlike and are probably more shallow in depth than the terrace deposits nearer to the streams. No roadway or bridge borings were available for kames and outwash terraces, however, representative profiles were made from the agricultural map data and are shown in the lower left of the engineering soils map of Clinton County.

Fine Textured Glacial Sluiceways

The elongate glacial sluiceway deposits in the southern third of the county are characteristically a sandy silt or silt loam with some clay. These deposits are generally less coarse in texture than the previously mentioned terrace meltwater deposits because the velocity of the water was lower resulting in smaller particle size carrying capacity. In many places these former sluiceways are now drained by ditches. Soils found developed on meltwater deposits in Clinton County include the following:

Soil Series/Association	Deposit	Percent of Area
Ockley	terrace	0.9
Fox	terrace	0.3
Westland	terrace	0.3
Sleeth	terrace & sluiceway	0.2
Martinsville	sluiceway	0.6
Brenton	sluiceway	0.2
Whitaker	sluiceway	0.7
Proctor	sluiceway	0.2
	Total	3.4 Percent

A typical borehole log for sluiceway deposits was derived from boring data along Interstate 65 and is shown below:

Glacial Sluiceways (borings 5 and 13)

Depth (feet)	Textural Classification	AASHTO	P.I.
0-2	Light brown silt loam	A-7-5(16) A-6(0-10)	22
2-4	Gray-brown sandy loam with trace gravel	A-4(2)	5
4-6	Brown sandy loam with trace gravel	A-4(0-4)	7

Alluvial Deposits

Alluvial deposits include all fluvial sediments found between stream valley walls not related to glacial activity. These deposits include flood plains, post-glacial (valley-side) terraces and terraces of circumnavigation as well as channel and point bars. Terraces are given a separate land form-parent material symbol on the accompanying map, but are herein discussed with the other alluvial deposits for the sake of convenience.

Terrace Deposits

Terrace deposits are given a separate symbol because they are unique land forms with unique engineering characteristics. In Clinton County,terraces are typically composed primarily of fine to medium sand with some interbedding of silt and gravel. Generally speaking, field sampling indicated high terraces to be more coarse while within any given terrace no distinct lateral gradation was observed. Terrace deposits are found on Kilmore and Sugar Creeks and the Middle Fork and South Fork of Wildcat Creek and their tributaries. The following soils are found on terrace deposits in Clinton County:

Soil Series/Association	Percent of County Area
Ockley	0.9
Whitaker	0.7
Fox	0.3
Westland	0.3
Sleeth	0.2
Total	2.4 Percent

These same series have developed on coarse-textured meltwater deposits and thus have been listed twice. It is not always easy to differentiate between outwash and post-glacial terraces, however, they are similar enough in texture to be considered together and to conclude that their combined area is between 2.4%-3.4% of the county area. Sluiceway deposits are not texturally analogous to the terrace deposits and probably account for most of the 1% balance between terrace and meltwater deposit areas. No borehole data is available for terrace deposits in Clinton County. However, a representative profile is provided and is shown on the left-hand side of the engineering soils map.

Flood Plains

Soils on flood plain deposits are typically silty loams and silty clay loams with lenses of sand. Flood plains are best developed along Kilmore Creek and the Middle Fork and Southern Branch of Wildcat Creek. Soils that have developed on floodplains include:

Soil Series/Association		Percent of County Area
Ceresco		2.7
Sloan		0.5
Genesee		0.5
Landes		0.3
	Total	4.0 Percent

Summation and generalization of borehole data for bridgework on SR 29 over Kilmore Creek showed the following vertical textural variation:

Flood Plain (boreholes 28, 29, 30, 31)

Depth (feet)	Textural Classification
0-3	Brown silty clay loam with sand and trace gravel
3-6	Brown silty clay loam with sand and trace gravel
6-10	Gray silty clay loam with sand

Data for other boreholes in fluvial drift in Clinton County is shown in Appendix A.

Depressional Deposits

Depressional deposits included areas of peat and muck and highly organic topsoils found in enclosed, low-lying areas in the ground and ridge moraine. Areas of peat and muck are most common in the northern third of the county in association with lows in ridge moraine and are here inferred to be associated with ice block depressions or kettles. Patches of peat and muck are also found in wooded bogs in the ground moraine and between flood plains and valley walls in the northern two-thirds of the county. Highly organic topsoils were located on aerial photographs as flat, low-lying areas with overall dark photo-tones. Areas of highly organic topsoils are found most commonly in ground moraine and are scattered primarily throughout the southern two-thirds of the county, often occurring in clusters. Textural profiles on the map which accompanies this report indicate expected textural gradation with depth and the extent of organic matter for areas of peak and muck and highly organic topsoils. Soil Series containing peat and muck are the following:

Soil Series/Association	Percent of County Area
Houghton	0.1
Palms	0.1
Wallkill	0.1
Total	0.3 Percent

Soil Series associated with areas of highly organic topsoils are:

Soil Series/Association	Percent of County Area
Treaty	5.6
Starks	2.5
Patton	1.6
Milford	0.9
Total	10.6 Percent

Shallow Lacustrine Deposits

Several large (approx. 1/2 square mile) shallow-basin features are found in Clinton County, particularly in the northeast and southwestern portions of the county. They are flat and are generally bounded by a 3 to 5 foot topographic rise in the land surface. These features are similar to areas of highly organic topsoil in both form and photo-tone as they appear in aerial photographs. However, field sampling showed that the larger forms were commonly underlain by a 4"-6" layer of highly plastic clays at a depth of 2′-4′, a characteristic not found in the smaller areas of highly organic topsoil. It was then possible to differentiate these similar features on the basis of size on the aerial photographs.

Although the large, basin forms were not bordered by any true beach ridges and soil sampling revealed no varves or other layering systems, they have been designated as lacustrine soils in the Agricultural Soil Survey and are herein called shallow lacustrine deposits based on the presence of the clay layer, flat topography, overall dark photo tones, and the addition of man-made drainage ditches. The absence of identifiable beach ridges or any obvious change toward coarser material at the borders of these features may be explained by a lack of adequate fetch and water depth necessary to generate waves large enough to produce such a lateral gradation in texture. However, wave action and water turbulence may have been great enough throughout the entire

water mass to prevent any noticeable layering effect due to intermittent agitation of deposited sediments during periods of high wind.

As with areas of peat and muck, the shallow lacustrine deposits may present special engineering problems, some of which are tabulated in Appendix B in the back of this report. Soils found on the shallow lacustrine deposits in Clinton County include:

Soil Series/Association	Percent of County Area
Ragsdale	4.8
Starks	2.5
Mahalasville	2.4
Patton	1.6
Milford	0.9
Total	12.2 Percent

As has been noted previously, some of the soil series mentioned in this part of the report have developed in more than one engineering soil area. This occurrence is to be expected where parent material and depositional environments are similar, as in the case of shallow lacustrine and areas of highly organic topsoil. Only the soil series of greatest areal extent have been included in the general summation of the percentage of the county area occupied by any given engineering soil area. In spite of the overlap of some soil series and the complete omission of others, summation of the engineering soils areas accounted for 98.4 percent of the county area. This figure would tend to lend credence to the estimates obtained for the percentage of the county area covered by the various engineering soils areas in

spite of the overlap of some soil series between one or more of the parent material-land form associations.

Effect of the Loess Cover

A blanket of loess ranging in thickness from three feet in the southwest corner to one foot in the northeast corner at one time covered all of Clinton County (10). Subsequent water erosion has removed most of the loess cover from areas of alluvial activity, minimizing its effect upon surface soil and profile development in these areas. Elsewhere, however, the loess has influenced greatly the surface soil texture and to a lesser degree, soil profile development.

In areas where the loess exceeded two feet at the time of deposition, it dominates the surface soil texture and probably has affected any underlying soil profile development by infiltration of silt-sized particles. Surface soils throughout the county are predominantly silts, clayey silts, silt loams, and clayey silt loams. In areas where the loess is 1 to 2 feet or less thick, it probably has not influenced subsurface soil profile development quite as significantly, although it is still the dominant surface soil.

The deposition of the loess has, in effect, resulted in a generally fine textured, silty surface soil throughout most of the county. It has provided a medium for the development of some of the finest agricultural soils in the State of Indiana. However, the loess has also brought with it the problems associated

with silts, such as fairly poor permeability, the likelihood of frost heave, and the possibility of shrink-swell action of accumulated clays.

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APPENDIX A - SUMMARY OF BOREHOLE DATA*

Borehole Map Number	Station	Offset (ft.)	Depth (ft.)	AASHTO	Texture	Percent Composition				Plasticity Limits		
						G	S	M	C	LL	PL	PI
Job - I-65 Starting at Tippecanoe-Clinton County Line (12)												
1	115+00	10'Lt.	2.5-4.0	A-6(9)	Brown & Gray Clay	0	26	38	36	32	20	12
2	1125+00	42'Rt.	3.5-4.5	A-2-4(0)	Gray, Sandy Loam	0	73	16	11	19	16	3
3	1134+30		1.0-3.0	A-7-6(20)	Dark Brown Silty Clay, trace organic	0	6	63	31	59	25	34
4	1144+00	65'Rt.	3.5-4.0	A-7-6(20)	Gray Clay	0	1	41	58	81	25	56
5	1150+00		2.5-4.5	A-4(2)	Light Brown Sandy Loam	0	57	37	6	18	12	6
6	1169+00		4.0-7.0	A-7-6(19)	Gray Silty Clay Loam	0	7	64	29	54	20	34
Job - Project I-65-5(23) 149 (13)												
7	1013+00	50'Lt.	2.0-4.0	A-7-6(19)	Brown-Gray Silty Clay	0	5	50	45	56	19	37
8	984+00		2.0-4.0	A-6(10)	Brown-Gray Silty Clay Loam	0	2	73	25	36	21	15
9	965+00	50'Lt.	2.0-4.0	A-7-6(18)	Silty Clay	0	7	51	42	49	19	30
10	946+00	50'Rt.	2.0-4.0	A-6(8)	Brown-Gray Silty Clay Loam	0	5	75	20	32	21	11
11	919+25	50'Rt.	4.0-6.0	A-4(4)	Brown-Gray Clay Loam w/ trace gravel	10	37	33	20	21	15	6
12	910+00	50'Rt.	2.0-4.0	A-7-6(18)	Mottled, Gray-Brown Silty Clay w/trace organic	0	2	59	39	52	23	29
13	883+50	50'Lt.	2.0-4.0	A-4(1)	Gray, Sandy Loam w/ trace gravel	1	59	27	13	21	17	4
14	848+00	50'Lt.	4.0-6.0	A-6(12)	Mottled, Brown Gray Silty Clay	0	2	64	34	39	20	19

Borehole Map Number	Station	Offset (ft.)	Depth (ft.)	AASHTO	Texture	Percent Composition				Plasticity Limits		
						G	S	M	C	LL	PL	PI
15	974+00	50'Rt.	2.0-4.0	A-7-6(16)	Mottled Brown Gray Silty Clay	0	10	54	36	46	19	27
16	788+00	50'Lt.	4.0-6.0	A-6(7)	Brown-Gray Clay Loam	4	33	40	23	29	16	13
17	764+00	50'Lt.	2.0-4.0	A-7-6(18)	Mottled, Gray-Brown Silty Clay	0	7	51	42	50	18	32
18	704+00	50'Lt.	4.0-6.0	A-4(5)	Brown-Gray Clay Loam w/ trace gravel	7	33	35	25	23	15	8
19	672+50	50'Lt.	3.0-4.0	A-6(9)	Gray, Silty Clay Loam	0	6	68	26	33	21	12
20	633+00	50'Lt.	4.0-5.0	A-7-5(19)	Brown, Silty Clay Loam w/little organic	0	15	58	27	65	37	28
Job - S.R. 38 and Sugar Creek (14)												
21	350+00		4.0-5.0	A-4(0)	Sandy Loam	9	56	20	8	17	12	5
22	358+75	25'Lt.	5.0-6.0	A-4(4)	Sandy Loam	4	49	31	17	15	11	5
23	358+90	15'Rt.	5.0-6.0	A-7-6(3)	Sandy Clay Loam	19	47	14	20	41	19	21
Job - S.R. 38 @ McClamrock Ditch (15)												
24	423+25	30'Lt.	5.0-7.0		Sandy Clay Loam w/gravel							
25a	423+65	20'Rt.	2.0-5.0		Sandy Loam w/trace gravel							
25b	423+65	20'Rt.	5.0-8.0		Fine Sand							
26a	423+82	38'Lt.	4.5-6.5		Stiff, coarse Sand and Loam							
26b	423+82	38'Lt.	6.5-14.9		Coarse Sand w/ trace gravel							

Appendix A - Continued

Borehole Map Number	Station	Offset (ft.)	Depth (ft.)	AASHTO	Texture	Percent Composition				Plasticity Limits		
						G	S	M	C	LL	PL	PI
Job - S.R. 29 @ Kilmore Creek (16)												
27a	276+00	30'Lt.	0.0-3.0		Silty Clay Loam							
27b	276+00	30'Lt.	3.0-7.3	A-4(4)	Clay Loam							
28a	276+90	20'Rt.	0.0-3.0		Silty Clay Loam w/ trace gravel							
28b	276+90	20'Rt.	3.0-7.0		Silty Clay Loam w/sand							
29a	277+32	25'Rt.	0.0-3.0		Sand w/gravel							
29b	277+32	25'Rt.	3.0-12.0		Silty Clay Loam w/gravel							
30a	277+78	25'Rt.	0.0-3.0		Silty Clay							
30b	277+78	25'Rt.	3.0-5.5		Silty Clay Loam							
30c	277+78	25'Rt.	5.5-10.5		Sand							
31a	278+18	25'Lt.	0.0-4.5		Silty Clay Loam							
31b	278+18	25'Lt.	4.5-5.5		Sandy Loam							
31c	278+18	25'Lt.	5.5-6.5		Silty Clay							
31d	278+18	25'Lt.	6.5-8.0		Sand							
Job - S.R. 75 over Kilmore Creek (17)												
32a	201+00	11'Rt.	1.0-3.0		Sandy Loam							
32b	201+00	11'Rt.	3.0-8.5		Loam							
32c	201+00	11'Rt.	8.5-14.0		Loam							
33a	201+65	15'Rt.	0.0-4.0		Silty Laom							
33b	201+65	15'Rt.	4.0-5.5		Sand and Gravel							
33c	201+65	15'Rt.	5.5-9.0		Loam							

Appendix A - Continued

Borehole Map Number	Station	Offset (ft.)	Depth (ft.)	AASHTO	Texture	Percent Composition G	S	M	C	Plasticity Limits LL	PL	PI
34	202+15	15'Rt.	1.5-14.0		Sand w/trace gravel							
35a	202+80	25'Lt.	0.0-2.5		Sandy Loam							
35b	202+80	25'Lt.	2.5-5.5		Silty Loam							
35c	202+80	25'Lt.	5.5-8.0		Wood							
Job - Frankfort S.R. 421 (18)												
36	103+86	39'Rt.	3.0-6.0	A-7-6(16)	Silty Clay Loam	2	22	52	25	42	21	21
37	105+64	34'Lt.	1.0-11.5	A-4(0)	Sandy Loam	12	41	40	7	NP	NP	NP
38	106+62	29'Lt.	1.0-7.5	A-4	Sandy Loam							
39	109+05	22'Lt.	2.5-4.0	A-6(13)	Clay Loam	1	26	48	25	40	20	20

*Note: This data was obtained from consultant work done for the Indiana State Highway Commission. For more detailed information, the reader is referred to the footnoted reference which appears after each job title.

APPENDIX B - TABL

Soil name and map symbol	Depth	'O	Percentage passing sieve number--				Liquid limit	Plasticity index
			4	10	40	200		
	In						Pct	
Be----------------	0-11	-4	100	95-100	95-100	80-100	30-40	5-15
Brenton	11-40	-7	100	95-100	95-100	75-95	35-50	10-25
	40-60		95-100	85-100	80-100	30-85	20-35	5-20
Ce----------------	0-14	-4	100	100	60-90	30-75	10-20	NP-6
Ceresco	14-60	-4	95-100	80-100	60-95	15-80	15-30	NP-8
Crosby----------	0-8	-6	100	95-100	80-100	50-90	22-34	6-15
	8-31	-7	92-99	89-97	78-93	64-76	37-55	17-31
	31-60	-6	88-94	83-89	74-87	50-64	17-30	2-14
Cy----------------	0-14	-6	100	100	95-100	80-95	25-40	5-15
Cyclone	14-49	-7	100	100	95-100	85-95	30-50	15-30
	49-60	-6	95-100	85-100	80-95	50-80	25-40	4-15
	60-70	-6	90-100	85-100	75-95	50-75	20-30	6-15
Dr----------------	0-14	-7	100	95-100	85-100	72-95	30-50	15-30
Drummer	14-39	-7	100	95-100	85-100	70-90	30-50	15-30
	39-62	-7	95-100	90-100	75-95	60-85	30-50	15-30
	62-70	-6	95-100	85-95	75-95	50-80	20-35	7-20
FcA---------------	0-13	-6	100	95-100	90-100	75-93	27-36	4-12
Fincastle	13-32	-7	100	100	95-100	85-95	38-54	20-32
	32-59		95-100	90-98	85-95	75-85	45-58	30-38
	59-70		88-96	82-90	70-86	50-66	20-30	3-10
FsB---------------	0-8		95-100	85-100	75-95	55-90	20-30	3-10
Fox	8-11	-7	85-100	75-100	70-95	55-90	25-50	10-25
	11-35		85-100	75-95	50-95	20-65	25-45	10-25
	35-60		40-100	35-100	15-95	2-20	---	NP
Gn----------------	0-9	A-6	100	100	90-100	75-85	26-40	3-15
Genesee	9-40	A-6	100	95-100	85-95	75-85	26-40	3-15
	40-49	A-6	95-100	90-100	60-80	50-70	20-40	3-15
	49-60		95-100	85-100	45-70	5-20	---	NP
Ho----------------	0-60		---	---	---	---	---	---
Houghton								
La----------------	0-10		100	95-100	85-95	35-55	25-40	NP-10
Landes	10-60	A-4	100	95-100	60-95	10-70	<30	NP-10

APPENDIX B - TABLE OF ESTIMATED ENGINEERING SOIL PROPERTIES (2)

Soil name and map symbol	Depth	Permeability	Shrink-swell potential	High water table			Potential frost action	Risk of corrosion		Depth	USDA texture	Classification		Percentage passing sieve number--				Liquid limit	Plasticity index
				Depth*	Kind	Months		Uncoated steel	Concrete			Unified	AASHTO	4	10	40	200		
	In	In/hr		Ft						In								Pct	
Be Brenton	0-11	0.6-2.0	Low	1.0-3.0	Apparent	Mar-Jun	High	High	Moderate.	0-11	Silt loam	CL, ML	A-6, A-4	100	95-100	95-100	80-100	30-40	5-15
	11-40	0.6-2.0	Moderate							11-40	Silty clay loam, loam.	CL, ML	A-6, A-7	100	95-100	95-100	75-95	35-50	10-25
	40-60	0.6-2.0	Low							40-60	Stratified silt loam to loamy sand.	CL-ML, CL, SM-SC, SC	A-4, A-6, A-2	95-100	85-100	80-100	30-85	20-35	5-20
Ce Ceresco	0-14	2.0-6.0	Low	1.0-2.0	Apparent	Sep-May	High	Low	Low.	0-14	Loam	SM, ML, CL-ML, SM-SC	A-2, A-4	100	100	60-90	30-75	10-20	NP-6
	14-60	0.6-6.0	Low							14-60	Sandy loam, loamy sand, loam.	SM, ML, CL, SC	A-2, A-4	95-100	80-100	60-95	15-80	15-30	NP-8
Crosby	0-8	0.6-2.0	Low	1.0-3.0	Apparent	Jan-Apr	High	High	Moderate.	0-8	Silt loam	CL, CL-ML	A-4, A-6	100	95-100	80-100	50-90	22-34	6-15
	8-31	0.06-0.2	Moderate							8-31	Clay loam, silty clay loam.	CL, CH	A-6, A-7	92-99	89-97	76-93	64-76	37-55	17-31
	31-60	0.06-0.2	Low							31-60	Loam	CL, ML, CL-ML	A-4, A-6	88-94	83-89	74-87	50-64	17-30	2-14
Cy Cyclone	0-14	0.6-2.0	Low	+.5-1.0	Apparent	Dec-May	High	High	Low.	0-14	Silt loam	CL, CL-ML	A-4, A-6	100	100	95-100	80-95	25-40	5-15
	14-49	0.6-2.0	Moderate							14-49	Silty clay loam	CL	A-6, A-7	100	100	95-100	85-95	30-50	15-30
	49-60	0.6-2.0	Moderate							49-60	Loam	CL, CL-ML	A-4, A-6	95-100	85-100	80-95	50-60	25-40	4-15
	60-70	0.2-0.6	Low							60-70	Loam	CL-ML, CL	A-4, A-6	90-100	85-100	75-95	50-75	20-30	6-15
Dr Drummer	0-14	0.6-2.0	Moderate	+.5-2.0	Apparent	Dec-May	High	High	Moderate.	0-14	Silty clay loam	CL	A-6, A-7	100	95-100	85-100	72-95	30-50	15-30
	14-39	0.6-2.0	Moderate							14-39	Silty clay loam, silt loam, clay loam.	CL	A-6, A-7	100	95-100	85-100	70-90	30-50	15-30
	39-62	0.6-2.0	Moderate							39-62	Loam, silt loam, clay loam.	CL	A-6, A-7	95-100	90-100	75-95	60-85	30-50	15-30
	62-70	0.6-2.0	Low							62-70	Loam	CL	A-4, A-6	95-100	85-95	75-95	50-80	20-35	7-20
FcA Fincastle	0-13	0.6-2.0	Low	1.0-3.0	Apparent	Jan-Apr	High	High	Moderate.	0-13	Silt loam	CL, ML	A-4, A-6	100	95-100	90-100	75-93	27-36	4-12
	13-32	0.2-0.6	Moderate							13-32	Silty clay loam, silt loam.	CL, CH	A-6, A-7	100	100	95-100	85-95	38-54	20-32
	32-59	0.2-0.6	Moderate							32-59	Clay loam, loam	CH, CL	A-7	95-100	90-98	85-95	75-85	45-58	30-38
	59-70	0.06-0.2	Low							59-70	Loam	CL, ML, CL-ML	A-4	88-96	82-90	70-86	50-66	20-30	3-10
FsB Fox	0-8	0.6-2.0	Low	>6.0	---	---	Moderate	Low	Moderate.	0-8	Silt loam	ML, CL, CL-ML	A-4	95-100	85-100	75-95	55-90	20-30	3-10
	8-11	0.6-2.0	Moderate							8-11	Silty clay loam, silt loam, clay loam.	CL	A-6, A-7	85-100	75-100	70-95	55-90	25-50	10-25
	11-35	0.6-2.0	Moderate							11-35	Clay loam, gravelly clay loam, sandy clay loam.	CL, SC	A-2, A-6, A-7	85-100	75-95	50-95	20-65	25-45	10-25
	35-60	>6.0	Low							35-60	Sand and gravel	SP, SM, GP, GM	A-1, A-2, A-3	40-100	35-100	15-95	2-20	---	NP
Gn Genesee	0-9	0.6-2.0	Low	>6.0	---	---	Moderate	Low	Low.	0-9	Silt loam	ML, CL	A-4, A-6	100	100	90-100	75-85	26-40	3-15
	9-40	0.6-2.0	Low							9-40	Loam, silt loam	ML, CL	A-4, A-6	100	95-100	85-95	75-85	26-40	3-15
	40-49	0.6-2.0	Low							40-49	Sandy loam, loam.	ML, CL-ML, CL	A-4, A-6	95-100	90-100	60-80	50-70	20-40	3-15
	49-60	6.0-20	Low							49-60	Sand	SM, SP-SM	A-1, A-2, A-3	95-100	85-100	45-70	5-20	---	NP
Ho Houghton	0-60	0.2-6.0	---	+.5-1.0	Apparent	Sep-Jun	High	High	Low.	0-60	Sapric material	Pt	A-8	---	---	---	---	---	---
La Landes	0-10	2.0-6.0	Low	>6.0	---	---	Moderate	Low	Low.	0-10	Fine sandy loam	SM, ML	A-4	100	95-100	85-95	35-55	25-40	NP-10
	10-60	6.0-20	Low							10-60	Stratified fine sand to silt loam.	SM, ML, SP-SM, SC	A-2, A-4	100	95-100	60-95	10-70	<30	NP-10

APPENDIX B -

Soil name and map symbol	Depth	Pe	Percentage passing sieve number--			Liquid limit	Plasticity index
			10	40	200		
	In					Pct	
Ma--------------- Mahalasville	0-16	0	100	95-100	85-95	38-54	20-32
	16-35	0	100	95-100	85-95	38-54	20-32
	35-44	100	90-95	85-95	60-75	22-35	3-15
	44-60	90	70-80	50-80	10-60	15-30	NP-10
McA, McB2-------- Martinsville	0-10	0	90-100	80-100	60-90	22-33	4-12
	10-34	0	90-100	65-90	40-90	20-35	8-20
	34-58	0	90-100	60-80	30-60	30-40	2-8
	58-75	100	85-100	80-95	40-60	<25	4-9
MtB*: Miami------------	0-8	0	95-100	80-100	50-90	22-34	6-15
	8-36	99	89-97	78-95	64-95	35-50	17-31
	36-60	94	83-89	74-87	50-64	17-30	2-14
Mx--------------- Milford	0-17	0	95-100	90-100	80-95	40-60	20-35
	17-38	0	95-100	90-100	75-100	40-60	20-40
	38-60	100	95-100	90-100	70-100	30-50	15-30
OcA, OcB--------- Ockley	0-9	00	95-100	80-100	60-90	22-33	3-12
	9-25	00	75-100	65-90	50-90	35-50	15-30
	25-51	-85	45-75	40-70	35-55	30-50	15-30
	51-60	-70	20-55	5-20	2-10	---	NP
Pc--------------- Palms	0-26	--	---	---	---	---	---
	26-60	-100	80-100	70-95	50-90	25-40	5-20
Pn--------------- Patton	0-12	00	100	95-100	75-95	30-40	10-20
	12-30	00	100	95-100	80-100	40-55	15-25
	30-60	00	100	95-100	75-95	25-40	10-20
Pt--------------- Proctor	0-16	00	100	95-100	85-100	25-40	10-22
	16-65	-100	90-100	85-100	65-90	25-50	10-25
	65-70	-100	80-100	50-100	25-80	20-40	5-20

APPENDIX B - Continued

Soil name and map symbol	Depth	Permeability	Shrink-swell potential	High water table			Potential frost action	Risk of corrosion		Depth	USDA texture	Classification		Percentage passing sieve number--				Liquid limit	Plasticity index
				Depth*	Kind	Months		Uncoated steel	Concrete			Unified	AASHTO	4	10	40	200		
	In	In/hr								In								Pct	
Ma Mahalasville	0-16	0.2-0.6	Moderate	+.5-1.0	Apparent	Dec-May	High	High	Low.	0-16	Silty clay loam	CL, CH	A-6, A-7	100	100	95-100	85-95	38-54	20-32
	16-35	0.06-0.2	Moderate							16-35	Silty clay loam	CL, CH	A-6, A-7	100	100	95-100	85-95	38-54	20-32
	35-44	0.06-0.2	Low							35-44	Loam, clay loam	ML, CL-ML, CL	A-6, A-4	95-100	90-95	85-95	60-75	22-35	3-15
	44-60	2.0-6.0	Low							44-60	Stratified silt to sand.	CL, SC, SP-SC, CL-ML	A-4, A-2-4	75-90	70-80	50-80	10-60	15-30	NP-10
McA, McB2 Martinsville	0-10	0.6-2.0	Low	>6.0	---	---	Moderate	Moderate	Moderate.	0-10	Silt loam	CL, CL-ML	A-4, A-6	100	90-100	80-100	60-90	22-33	4-12
	10-34	0.6-2.0	Moderate							10-34	Clay loam, silty clay loam, sandy clay loam.	CL, SC	A-4, A-6	100	90-100	65-90	40-90	20-35	8-20
	34-58	0.6-2.0	Low							34-58	Sandy loam, sandy clay loam, loamy sand.	SM, ML	A-2-4, A-4	100	90-100	60-80	30-60	30-40	2-8
	58-75	0.6-2.0	Low							58-75	Stratified sand to silt loam.	CL, SC, CL-ML, SM-SC	A-4	95-100	85-100	80-95	40-60	<25	4-9
MtB*: Miami	0-8	0.6-2.0	Low	>6.0	---	---	Moderate	Moderate	Moderate	0-8	Silt loam	CL, CL-ML	A-4, A-6	100	95-100	80-100	50-90	22-34	6-15
	8-36	0.6-2.0	Moderate							8-36	Clay loam, silty clay loam, loam.	CL	A-6, A-7	92-99	89-97	78-95	64-95	35-50	17-31
	36-60	0.2-0.6	Low							36-60	Loam, sandy loam.	CL, CL-ML, ML	A-4, A-6	88-94	83-89	74-87	50-64	17-30	2-14
Mx Milford	0-17	0.6-2.0	High	+.5-2.0	Apparent	Dec-May	High	High	Low.	0-17	Silty clay loam, silty clay.	CL, CH	A-7	100	95-100	90-100	80-95	40-60	20-35
	17-38	0.06-0.2	Moderate							17-38	Silty clay, silty clay loam, silt loam.	CH, CL	A-7	100	95-100	90-100	75-100	40-60	20-40
	38-60	0.2-0.6	Moderate							38-60	Stratified silty clay loam to sandy loam.	CL	A-6, A-7	97-100	95-100	90-100	70-100	30-50	15-30
OcA, OcB Ockley	0-9	0.6-2.0	Low	>6.0	---	---	Moderate	Moderate	Moderate	0-9	Silt loam	CL, ML, CL-ML	A-4, A-6	100	95-100	80-100	60-90	22-33	3-12
	9-25	0.6-2.0	Moderate							9-25	Silty clay loam, clay loam.	CL	A-6, A-7	100	75-100	65-90	50-90	35-50	15-30
	25-51	0.6-2.0	Moderate							25-51	Gravelly clay loam, gravelly sandy clay loam.	CL, SC, GC	A-6, A-7	70-85	45-75	40-70	35-55	30-50	15-30
	51-60	>20	Low							51-60	Stratified sand to very gravelly coarse sand.	SP, SP-SM, GP, GP-GM	A-1	30-70	20-55	5-20	2-10	---	NP
Pc Palms	0-26	2.0-6.0	---	+.5-1.0	Apparent	Nov-May	High	High	Moderate	0-26	Sapric material	Pt	---	---	---	---	---	---	---
	26-60	0.2-2.0	Low							26-60	Clay loam, silt loam, loam.	CL-ML, CL	A-4, A-6	85-100	80-100	70-95	50-90	25-40	5-20
Pn Patton	0-12	0.6-2.0	Moderate	+.5-2.0	Apparent	Dec-May	High	High	Low.	0-12	Silty clay loam	CL	A-6	100	100	95-100	75-95	30-40	10-20
	12-30	0.6-2.0	Moderate							12-30	Silty clay loam	CL, CH, ML, MH	A-7	100	100	95-100	80-100	40-55	15-25
	30-60	0.6-2.0	Moderate							30-60	Stratified silt loam to silty clay loam.	CL	A-6	100	100	95-100	75-95	25-40	10-20
Pt Proctor	0-16	0.6-2.0	Low	2.5-6.0	Apparent	Jan-May	High	Moderate	Moderate	0-16	Silt loam	CL	A-6	100	100	95-100	85-100	25-40	10-22
	16-65	0.6-2.0	Moderate							16-65	Silty clay loam, clay loam, loam.	CL	A-7, A-6	95-100	90-100	85-100	65-90	25-50	10-25
	65-70	2.0-6.0	Low							65-70	Stratified loam to sand.	SC, CL, SM-SC, CL-ML	A-2, A-4, A-6	85-100	80-100	50-100	25-80	20-40	5-20

APPENDIX B

Soil name and map symbol	Depth	Percentage passing sieve number--				Liquid limit	Plasticity index
		4	10	40	200		
	In					Pct	
Ra----------------- Ragsdale	0-14	100	100	90-100	70-100	25-35	5-15
	14-50	100	100	90-100	80-95	35-50	15-30
	50-60	100	100	90-100	70-90	25-35	5-15
St----------------- Sleeth	0-12	100	90-100	75-95	50-85	20-35	3-15
	12-38	85-95	85-95	80-90	65-75	30-40	15-25
	38-50	65-95	60-85	55-70	50-70	30-40	15-25
	50-60	30-70	22-55	7-20	2-10	---	NP
Su----------------- Sloan	0-13	100	95-100	85-100	70-95	20-40	3-15
	13-50	100	90-100	85-100	75-95	30-45	8-18
	50-60	95-100	90-100	80-95	65-90	25-40	3-15
Sx----------------- Starks	0-10	100	100	95-100	85-100	22-35	5-15
	10-28	100	100	90-100	80-100	35-45	15-24
	28-55	95-100	90-100	80-95	40-80	20-40	6-17
	55-67	90-100	80-95	40-90	30-60	<30	NP-15
Ty----------------- Treaty	0-13	100	100	95-100	80-95	25-40	5-15
	13-36	100	100	95-100	85-95	30-50	15-30
	36-64	95-100	85-100	75-95	55-85	28-48	12-25
	64-70	90-100	85-95	75-90	55-75	20-30	6-15
Wa----------------- Wallkill	0-9	95-100	90-100	70-100	40-90	40-50	5-15
	9-22	75-100	70-100	60-100	40-90	15-25	5-10
	22-60	---	---	---	---	---	---
We----------------- Westland	0-9	100	95-100	90-100	75-90	30-45	10-25
	9-46	95-100	90-100	80-90	65-75	35-50	15-30
	46-54	65-75	60-70	55-70	50-70	30-50	15-30
	54-60	30-70	22-55	7-20	2-10	---	NP
Wh----------------- Whitaker	0-14	100	95-100	80-100	60-90	22-33	4-12
	14-44	100	95-100	90-100	70-80	30-47	12-26
	44-70	98-100	98-100	60-85	40-60	15-25	3-9

APPENDIX B - Continued

Soil name and map symbol	Depth	Permeability	Shrink-swell potential	High water table			Potential frost action	Risk of corrosion		Depth	USDA texture	Classification		Percentage passing sieve number--				Liquid limit	Plasticity index
				Depth*	Kind	Months		Uncoated steel	Concrete			Unified	AASHTO	4	10	40	200		
	In	In/hr		Ft						In								Pct	
Ra Ragsdale	0-14	0.6-2.0	Low	+.5-1.0	Apparent	Dec-May	High	High	Low.	0-14	Silt loam, silty clay loam.	CL, CL-ML	A-4, A-6	100	100	90-100	70-100	25-35	5-15
	14-50	0.06-0.2	Moderate							14-50	Silty clay loam, silt loam.	CL	A-6, A-7	100	100	90-100	80-95	35-50	15-30
	50-60	0.06-0.2	Low							50-60	Silt loam	CL, CL-ML	A-4, A-6	100	100	90-100	70-90	25-35	5-15
St Sleeth	0-12	0.6-2.0	Low	1.0-3.0	Apparent	Jan-Apr	High	High	Low.	0-12	Silt loam	CL, ML, CL-ML	A-4, A-6	100	90-100	75-95	50-85	20-35	3-15
	12-38	0.6-2.0	Moderate							12-38	Clay loam, silty clay loam, sandy clay loam.	CL	A-6	85-95	85-95	80-90	65-75	30-40	15-25
	38-50	0.6-2.0	Moderate							38-50	Gravelly clay loam, gravelly sandy clay loam, gravelly loam.	CL	A-6	65-95	60-85	55-70	50-70	30-40	15-25
	50-60	>20	Low							50-60	Stratified sand to gravelly sand.	SP, GP, SP-SM, GP-GM	A-1	30-70	22-55	7-20	2-10	---	NP
Su Sloan	0-13	0.6-2.0	Low	+.5-1.0	Apparent	Nov-Jun	High	High	Low.	0-13	Silt loam	CL, ML, CL-ML	A-6, A-4	100	95-100	85-100	70-95	20-40	3-15
	13-50	0.6-2.0	Moderate							13-50	Loam, clay loam, silt loam.	CL, ML	A-6, A-7, A-4	100	90-100	85-100	75-95	30-45	8-18
	50-60	0.6-2.0	Low							50-60	Stratified silty clay loam to sand.	ML, CL	A-4, A-6	95-100	90-100	80-95	65-90	25-40	3-15
Sx Starks	0-10	0.6-2.0	Moderate	1.0-3.0	Apparent	Mar-Jun	High	High	Moderate.	0-10	Silt loam	CL, CL-ML	A-4, A-6	100	100	95-100	85-100	22-35	5-15
	10-28	0.2-2.0	Moderate							10-28	Silty clay loam	CL	A-6, A-7	100	100	90-100	80-100	35-45	15-24
	28-55	0.2-2.0	Moderate							28-55	Sandy clay loam, silt loam, fine sandy loam.	CL, SC, CL-ML, SM-SC	A-4, A-6	95-100	90-100	80-95	40-80	20-40	6-17
	55-67	2.0-6.0	Very low							55-67	Stratified loamy sand to silt loam.	SM, SC, ML, CL	A-2, A-4, A-6	90-100	80-95	40-90	30-60	<30	NP-15
Ty Treaty	0-13	0.6-2.0	Low	+.5-1.0	Apparent	Dec-May	High	High	Low.	0-13	Silt loam	CL, CL-ML	A-4, A-6	100	100	95-100	80-95	25-40	5-15
	13-36	0.6-2.0	Moderate							13-36	Silty clay loam	CL	A-6, A-7	100	100	95-100	85-95	30-50	15-30
	36-64	0.6-2.0	Moderate							36-64	Clay loam, loam	CL	A-6, A-7	95-100	85-100	75-95	55-85	28-48	12-25
	64-70	0.2-0.6	Low							64-70	Loam	CL-ML, CL	A-4, A-6	90-100	85-95	75-90	55-75	20-30	6-15
Wa Wallkill	0-9	0.6-2.0	Low	+.5-0.5	Apparent	Sep-Jun	High	Moderate	Moderate.	0-9	Silt loam	ML, SM, OL	A-5, A-7	95-100	90-100	70-100	40-90	40-50	5-15
	9-22	0.6-2.0	Low							9-22	Silt loam, loam	CL, CL-ML, SM-SC, SC	A-4	75-100	70-100	60-100	40-90	15-25	5-10
	22-60	2.0-6.0	Low							22-60	Sapric material, hemic material, silt loam.	Pt	A-8	---	---	---	---	---	---
We Westland	0-9	0.6-2.0	Moderate	+.5-1.0	Apparent	Dec-May	High	High	Low.	0-9	Silty clay loam	CL	A-6, A-7	100	95-100	90-100	75-90	30-45	10-25
	9-46	0.06-0.2	Moderate							9-46	Clay loam	CL	A-6, A-7	95-100	90-100	80-90	65-75	35-50	15-30
	46-54	0.06-0.2	Moderate							46-54	Gravelly clay loam.	CL	A-6, A-7	65-75	60-70	55-70	50-70	30-50	15-30
	54-60	>20	Low							54-60	Stratified sand to gravelly sand.	SP, GP, SP-SM, GP-GM	A-1	30-70	22-55	7-20	2-10	---	NP
Wh Whitaker	0-14	0.6-2.0	Low	1.0-3.0	Apparent	Jan-Apr	High	High	Moderate.	0-14	Silt loam	CL, CL-ML	A-4, A-6	100	95-100	80-100	60-90	22-33	4-12
	14-44	0.6-2.0	Moderate							14-44	Clay loam, sandy loam, silty clay loam.	CL	A-6, A-7	100	95-100	90-100	70-80	30-47	12-26
	44-70	0.6-6.0	Low							44-70	Stratified coarse sand to clay.	CL, SC, ML, SM	A-4	98-100	98-100	60-85	40-60	15-25	3-9

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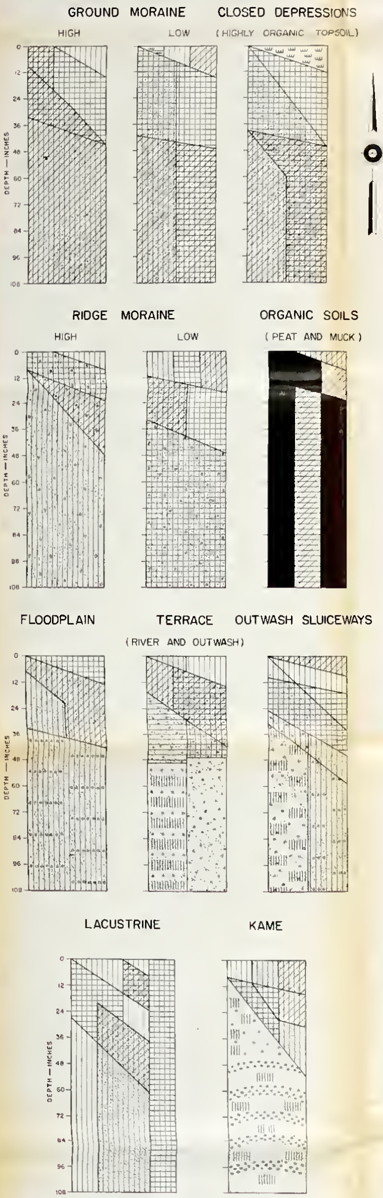
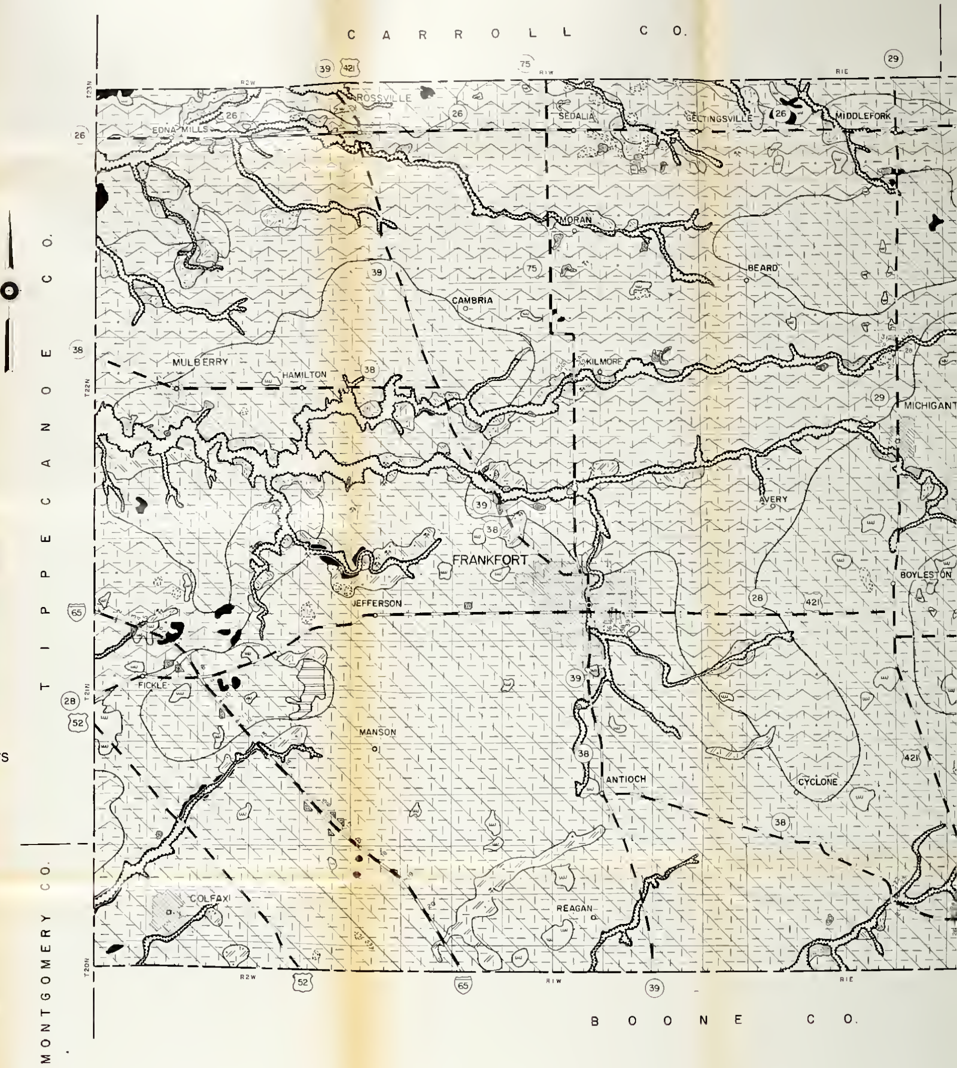
GENERAL SOIL PROFILES



TEXTURAL SYMBOLS FOR SOIL PROFILES

- ▥ SILT
- ▤ CLAY
- ▨ LOAM
- ☐ SAND
- ▦ GRAVEL
- ■ PEAT AND MUCK
- ▧ HIGHLY ORGANIC TOPSOIL

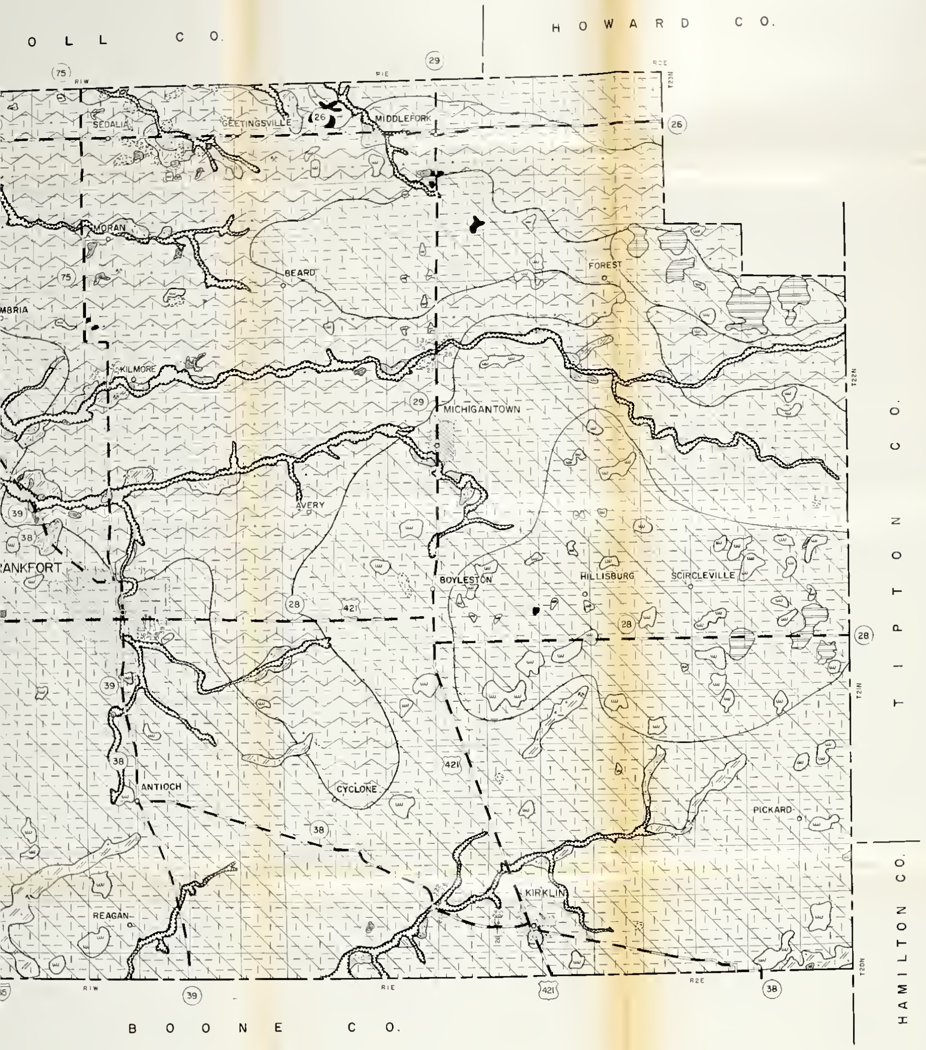


ENGINEERING SOILS MAP
CLINTON COUNTY
INDIANA

PREPARED FROM
1939 AAA AERIAL PHOTOGRAPHS
BY
JOINT HIGHWAY RESEARCH PROJECT
AT
PURDUE UNIVERSITY
1982

SCALE OF MILES
1 ¾ ½ ¼ 0 1 2 3 4

PREPARED UNDER THE SUPERVISION OF E M GEFELL AND R D MILES



LEGEND

PARENT MATERIALS
(GROUPED ACCORDING TO
LAND FORM AND ORIGIN)

- GROUND MORAINE
- SHALLOW WATER LACUSTRINE
- RIDGE MORAINE
- KAME AND ESKER
- OUTWASH (TERRACE OR SLUICEWAY)
- TERRACE (RECENT RIVER)
- ALLUVIAL PLAIN

MISCELLANEOUS

- GRAVEL PIT
- LAKE OR POND
- HIGHLY ORGANIC TOPSOIL
- PEAT AND MUCK
- BORING SITES

TEXTURAL SYMBOLS
(SUPERIMPOSED ON PARENT MATERIAL
TO SHOW RELATIVE COMPOSITION)

- GRAVEL
- SAND
- SILT
- CLAY

ENGINEERING SOILS MAP
CLINTON COUNTY
INDIANA

PREPARED FROM
1939 AAA AERIAL PHOTOGRAPHS
BY
JOINT HIGHWAY RESEARCH PROJECT
AT
PURDUE UNIVERSITY
1982

SCALE OF MILES
1 3/4 1/2 1/4 0 1 2 3 4

DRAWN BY A NISHIKAWA AND E P H CHEN

COVER DESIGN BY ALDO GIORGINI